Texscan

OPERATING AND INSTRUCTION MANUAL

Ref No 105/CA 2816

MODEL VS-50A

SWEEP GENERATOR

TEXSCAN CORPORATION

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1.10	SWEEP RATE	Five sweep rate modes are provided: (1) variable from 5 Hz to 60 Hz, (2) variable from 0.05 Hz to 5 Hz, (3) 50/60 Hz line rate, (4) manual sweep, and (5) external. The external sweep drive has an input impedance of approximately 100K ohms. A 24V peak-to-peak waveform will produce maximum dispersion. The unit will respond to input drive frequencies as high as 30 kHz.
1.11	ATTENUATION	The unit has a 0 to 6 dB vernier control of RF output. Two turret attenuators provide 0 to 80 dB attenuation in 1 dB steps.
1.12	ALC MONITOR	Both an internal leveling system and facility to use an external monitor are provided. If an external monitor is used, it must provide a DC signal of at least -1.0V DC for proper leveling.
1.13	RF OUTPUT CONNECTORS	BNC (standard). TNC, Type N, or Type F on special order.
1.14	HORIZONTAL DRIVE	A sawtooth waveform of at least 10V peak to peak is provided for oscilloscope horizontal drive. The horizontal output impedance is less than 10K ohms.
1.15	SIZE	6 7/8" x 17" x 16".
1.16	CONSTRUCTION	Aluminum with G-10 printed circuit boards.
1.17	WEIGHT	Approximately 21 lbs. Shipping weight is 26 lbs.
1.18	POWER	Approximately 15 watts. 50/60 Hz, 115/230 volts.
1.19	OPTIONS	
	1.19.1 75 Ohm Output Impedance	The VS-50 can be supplied with a 75 ohm output impedance. Option Z.

SECTION 1

SPECIFICATIONS

1.1	FREQUENCY RANGE	5 MHz to 500 MHz. The unit can be centered at any frequency between 5 MHz and 500 MHz and sweep within that range.
1.2	FREQUENCY DIAL ACCURACY	Within 1% of the maximum frequency.
1.3	SWEEP WIDTH	The sweep width is continuously variable from 500 kHz to 500 MHz at any center frequency, but the unit will not sweep above 500 MHz at rated output. The unit is also provided with a CW output mode for signal generator applications.
1.4	RF OUTPUT	The RF output is at least 1.0V rms into a 50 ohm load.
1.5	FLATNESS	The flatness is better than $\pm$0.25 dB at the maximum sweep width. As sweep width is narrowed, flatness improves. Typical readings at 10% sweep width are 0.1 dB or better (tested with a CD-51 detector).
1.6	HARMONIC DISTORTION AND SPURIOUS OUTPUT	In all modes of operation and from 10 MHz to 500 MHz, all unwanted frequency components are more than 25 dB below the desired output.
1.7	RESIDUAL FM	Less than 10 kHz.
1.8	LINEARITY	The linearity of output frequency versus time is within 1% of maximum sweep width as referenced to a straight line function.
1.9	MARKERS	The unit has a birdie-bypass marker system with provision for one to eight single frequency or harmonic markers. An external input is provided which can be used with a CW source to produce a variable marker. A 100 mV signal produces a marker greater than 1 volt peak to peak.

1.19.2 Variable Marker

A calibrated marker can be supplied with the following characteristics:

Frequency range: 5 MHz to 500 MHz.
Accuracy: (Principally determined by dial readability); 1.5 MHz or 1%, whichever is greater.
Marker amplitude: At least 1V peak-to-peak.
Marker width: Approximately 50 kHz to 200 kHz. Option M.

1.19.3 External Modulation

The unit can be supplied with uncalibrated external amplitude modulation capability. Option S.

1.19.4 Pen Lift Feature

A rear panel connector can be supplied which provides a short circuit during sweep time and an open circuit during retrace to use with the pen lift feature on an x-y recorder. Option P.

1.19.5 Rack Mount Kit

The VS-50 cabinet can be easily converted for rack mounting with this kit. Option RM.

1.20 RECOMMENDED ACCESSORIES

	TEXSCAN MODEL NUMBER
1.20.1 Log Detector	LN-40A.
1.20.2 RF Detector	CD-51.
* 1.20.3 Harmonic Markers	HM-1, HM-10, HM-50.
1.20.4 External Monitor	EM-50.
1.20.5 Cable Set	501.

* Special frequencies are available from Texscan type SM plug-in markers.

SECTION 2

GENERAL DESCRIPTION

2.1 GENERAL INFORMATION

The VS-50 sweep generator is a solid state instrument that provides wide frequency coverage, variable sweep rate, external marker capability, and complete control of the RF output level. This unit has provisions for accepting up to eight single frequency or harmonic plug-in markers for frequency identification. A birdie-bypass marker system is used, providing accurate marker placement. The VS-50 has many additional features including manual sweep and external leveling.

The transistors used are all silicon, and the low frequency circuits are assembled on high quality printed circuit boards for maximum reliability and serviceability.

The VS-50 covers the frequency range of 5 MHz to 500 MHz. A block diagram of the sweep system is shown in Figure 2-1. The output frequency of 5.0 to 500 MHz is derived by taking the low level heterodyne output of two oscillators and amplifying this output to 1.0 volt rms. Low level mixing is employed to maintain a low spurious output signal. As can be seen in Figure 2-1, the RF output is sampled and detected in the monitor block. This sample is amplified in the leveler circuitry, compared to a stable reference voltage, and the error voltage used to automatically alter the leveled B+ to the video amplifier to compensate for RF output level changes. This electronic servo system provides automatic leveling which maintains the sweep output flat to within $\pm$0.25 dB.

This same monitor system provides a sample of the RF signal for use in the birdie-bypass marker system. Markers are obtained by mixing the sweep sample with a CW source and amplifying a narrow band of frequencies around the resultant zero beat. These markers can be conveniently added to the detected output of the unit being tested by using the adder provided in the unit.

The VS-50 provides a wide range of output attenuation capability; an RF vernier attenuator with a 6 dB range, a 1 dB step attenuator, and a 10 dB step attenuator. The total is 86 dB of continuously variable output attenuation.

The variable sweep rate is possible because the unit is electronically swept with a varactor used as the voltage sensitive element of the sweep oscillator. The drive for the varactor is derived from a sawtooth generator and non-linear shaping circuit. The sawtooth waveform is reshaped to

compensate for the non-linear voltage versus capacitance characteristic of the varactor, thereby providing a linear frequency change with time.

2.2 INTRODUCTION

The block diagram of the VS-50 shown in Figure 2-1 can be divided into five major sections: (1) sweep drive and blanking circuits, (2) sweep oscillators and mixer, (3) video amplifier and leveler circuits, (4) power supply, and (5) marker circuits. Detailed schematic diagrams of the VS-50 are included in Section 6. The following paragraphs present a description of the circuit details of each of the major sections.

2.3 SWEEP DRIVE and BLANKING CIRCUITS

The sweep drive and blanking schematic is shown in Figure 6-2. This circuitry provides a properly phased and reshaped sweep drive signal for the varactors in each sweep oscillator. It also provides B+ to the sweep oscillators which can be blanked off during the sweep oscillator retrace time. Figure 6-2 is most easily understood by discussing the rate generator and then the linearity circuit.

2.3.1 Rate Generator

This circuit has five modes of operation corresponding to the five sweep rate modes provided with the VS-50. The five modes are achieved by changing the operating characteristics of the basic rate generator consisting of the Schmitt Trigger and Miller Integrator.

Transistors, Q101 and Q102 are incorporated in the Schmitt Trigger, and Q103 and Q104 are used in the Miller Integrator. This combination of a Schmitt Trigger and Miller Integrator provides rectangular and sawtooth waveforms with a fixed phase relationship. The rectangular wave is present at the collector of Q102; the sawtooth wave at the collector of Q104. The circuit provides these signals with constant amplitude over the frequency range of the rate generator.

The RC time constant of C102, R118, and R120B is adjusted by varying R120B, the sweep rate vernier front panel control, thereby changing the sweep rate for the 5 Hz to 60 Hz sweep rate mode. In the 0.05 Hz to 5 Hz sweep rate mode, parallel capacitors C102 and C103 in series with R117 and R120C determine the RC time constant with R120C the adjustable element.

The rectangular wave at the collector of Q102 is also used to drive the two blanking circuit modes. Selection of video or RF blanking is made at S102, an internal switch. See paragraph 2.3.3.

The sawtooth wave at the collector of Q104 is coupled to the linearity circuit. In the variable sweep rate modes the trigger-integrator circuits are free-running, and as pointed out, front panel adjustment R120 can be varied to change the sweep rate.

The sweep rate selector switch, S103 (the five pole sweep rate function switch), converts this basic rate generator to the other three modes of operation.

In line rate position of S103, a 50/60 Hz signal from the power transformer is coupled to the base of Q101. This signal locks the generator to the line frequency. The other poles of the switch select the circuit time constants to insure locking and provide the same signal amplitude as in the free-running modes.

In the manual sweep mode of operation, S103 bypasses the rate circuit and a DC drive signal for the linearity circuit is selected by varying R120A. The voltage swing available in the voltage divider circuit of R120A, R127, and R123 is applied at the base of Q105, and is sufficient to sweep the oscillators through their full tuning range.

In the external sweep position, an externally applied signal is coupled to the base of Q105 which sweeps the oscillators in the same manner as the signal from the rate circuit.

2.3.2 Linearity Circuit

Emitter follower, Q 5 is the coupling stage between the rate generator and the linearity circuit. The emitter follower output of the rate generator is coupled through a sweep width switch and potentiometer combination consisting of S101 and R134. This combination is used to adjust the amplitude of the sawtooth wave (or more correctly, the amplitude swing of the drive voltage) in two different ranges. This signal is amplified and phase split in the transistor stages, Q106, and Q107. The signals at the collectors of Q106 and Q107 are approximately equal in amplitude and 180 degrees out-of-phase.

The diode-break network consisting of CR104 through CR109, and R141 through R157 reshapes the drive signals at the collectors of these two transistors, Q106 and Q107. The diode-break network is piece-wise linear. For example, for an assumed combination of forward-biased and back-biased diodes, the circuit has a linear characteristic. As the voltages at the collectors of these two transistors decrease, each of these diodes conducts in sequence, and as a result, the output waveform is reshaped. These two, 180 degrees out-of-phase, reshaped, drive voltages are coupled to the varactors in the two sweep oscillators. R163, R164, and R167 are potentiometer controls for setting the DC level of the sweep drive voltages. R164 is the front panel center frequency adjustment. The sawtooth signal at the emitter of Q105 is also coupled to the front panel to provide the horizontal axis oscilloscope drive voltage.

2.3.3 Blanking Circuit

The purpose of the blanking circuit is to reduce the displayed vertical signal to a zero level during the sweep retrace. Blanking provides a baseline for the displayed signal and automatically provides a single signal trace. In this instrument two blanking modes are available.

video and RF. The instrument is normally shipped in the video blanking mode. The unit may be switched to RF blanking by means of internal switch, S102 which is located on the main printed circuit board. See Figure 6-5 in Section 6 of this manual.

The blanking signal originates in the rate generator at the collector of Q102, the Schmitt Trigger output. Its waveform is rectangular and the intervals are timed in the approximate ratio of 60 percent display to 40 percent retrace. This ratio is practically constant regardless of the sweep rate. Internal blanking is not provided in the manual or the external sweep rate positions of S103. Although the blanking signal is in synchronism with the sweep display and retrace, practical considerations may dictate the use of either video or RF blanking. Ultimate choice of the blanking mode depends on the operator and his experience.

2.3.3.1 Video Blanking

When S102 is in the video blanking position, the blanking signal is coupled through S102, S103, S101, and R170 to the gate of N-channel JFET, Q109, with the proper phase and magnitude to produce an on and off switching action from source-to-drain of the JFET. During the display interval, the source-to-drain impedance is high, and during retrace, the impedance is low. Since the drain is coupled to the vertical scope connector, J309, the video signal is alternately displayed when desired, and shunted to ground during retrace.

Higher oscillator stability is achieved since full power is applied to all high frequency circuits while operating in the video blanking mode. Switching transients which occur during turn on and turn off times at the beginning or end of the display time are eliminated. Video blanking also eliminates drift effects in the display linearity.

This discussion is based upon operation of the sweep generator as shown in Figure 3-2 in which the signal from the device under test is coupled through the detector to the video input connector. If the detected signal is coupled directly to the vertical oscilloscope input, the blanking action does not occur.

2.3.3.2 RF Blanking

With S102 in the RF blanking position, the blanking signal is coupled through S102, S103, S101, and R217 to the base of Q203. During the display interval, Q203 is driven to cutoff. This causes Q204 to conduct, and in turn B+ voltage is applied to the oscillator pair at C502. See Figure 6-3 in Section 6. In the blanked mode, Q203 conducts, Q204 is cutoff, and the B+ to the oscillator pair is also cutoff. VR201, a 28 volt zener diode, keeps the emitter impedance low, and helps to produce sharp blanking.

The blanked RF mode is useful when logarithmic amplifiers are used, since the offset voltage usually employed with these amplifiers are not completely blanked by the JFET. Using video blanking with logarithmic amplifiers

prevents the baseline from returning to zero during the blanking interval.

2.3.4 Summary of Sweep Drive and Blanking Circuits

The circuitry shown in Figure 6-2 of Section 6 provides retrace blanking (video or RF), horizontal oscilloscope drive, and the shaped varactor drive signals for the sweep oscillators. It includes a sweep rate switch with vernier control, a sweep width switch with vernier control, a center frequency control, and a blanking selector switch.

2.4 SWEEP OSCILLATORS and MIXER

The two sweep oscillators, mixer, and low-pass filter are shown in Section 6, Figure 6-3. The two sweep oscillators have essentially the same characteristics, each being a tuned line, varactor swept oscillator. One oscillator, using Q501 sweeps through the frequency range of 1350 MHz to 1600 MHz. The sweep drive voltage for this oscillator is coupled to the varactor, CV501, which changes the electrical length of the tuned line, and thereby changes the operating frequency.

The second sweep oscillator, using transistor, Q502 sweeps within the range of 1350 MHz to 1100 MHz. The varactor in this circuit is CV502. The outputs of these two sweep oscillators are coupled to the mixer diode, CR501. The lower sideband output from this mixer is passed through the low-pass filter, Z501, and delivered to the video amplifier. As the one oscillator is sweeping down in frequency, the other is sweeping up; consequently, the resultant output sweep width is twice as great as that provided by either oscillator. The double swept oscillator circuit tends to cancel non-linearities of the frequency characteristics caused by the varactors.

Center frequency is controlled by varying the DC level of the sweep drive to each oscillator, while sweep width is changed by varying the amplitude of the reshaped drive signal. The outputs of the two sweep oscillators are very loosely coupled to CR501 so that the mixing is accomplished at extremely low signal levels within the square-law region of the mixer diode. This low level mixing results in a low spurious output signal.

In the CW position, constant voltages are fed to the respective varactors of the two oscillators. It is equivalent to reducing the sweep width to zero so that the instrument may be used as a signal generator with the center frequency reading as an indicator of the beat frequency of the two oscillators. In this CW position, the base of Q106 is grounded.

2.5 VIDEO AMPLIFIER and AUTOMATIC LEVEL CONTROL

The circuitry shown in Figures 6-2 and 6-3 of Section 6 consists of a video amplifier, monitor, leveler, and output attenuators. Automatic level control (ALC) of the video output signal is effected in a closed-loop servo system consisting of the monitor, leveler, and the video amplifier.

2.5.1 Video Amplifier

The output signal from the low-pass filter, Z501 is coupled to the video amplifier input at J401. The input signal is amplified by four cascaded, RC-coupled, common emitter transistor amplifier stages. This four-stage video amplifier has a relatively flat response from 5 MHz to 500 MHz.

The first three stages are electrically similar. The leveled B+ voltage is coupled to the collector circuit of the third stage. A network of de-coupling capacitors and resistors also provides the B+ voltage to the first two stages. The networks suppress spurious oscillations and B+ line variations. Base bias is obtained from the B+ line by resistive voltage dividers. The respective emitter bias resistors are bypassed to provide flat frequency response over the entire operating range. An RF choke is connected in each B+ lead adjacent to the transistor collector to block the RF signal while permitting the DC collector bias current to flow.

The fourth stage of the video amplifier uses a transistor with a higher RF output rating. The transistor has two emitter leads which are coupled to the emitter bypass circuitry. Unregulated 50 volt B+ is supplied through a de-coupling RC network to the transistor collector.

The output of the video amplifier at the collector of Q404 is capacitance coupled to Z401, a feed-thru termination, consisting of a precision 50 ohm resistor which establishes the output impedance of the video amplifier. The output from Z401 is coupled through two rotary switch attenuators, Z603 and Z604 to the RF output connector, J609 on the front panel. The attenuator is adjustable from the front panel in 1 dB steps from 0 to 80 dB of attenuation.

2.5.2 Monitor

The monitor point is at the junction of C416 and Z401. A sample of RF output at Z401 is rectified and filtered by the monitor circuit. The monitor circuit consists of diode, CR401 and an RC compensating network which maintains amplifier flatness. The output of the monitor at feed-thru capacitor, C435 is a negative DC voltage.

2.5.3 Leveler

The leveler functions as a DC voltage regulator which supplies leveled B+ voltage to the first three stages of the video amplifier.

The negative DC monitor output voltage is coupled to the base of transistor, Q206, the leveler sampling input of the differential amplifier. The base of the other half of the differential amplifier, Q207 is coupled to a stable reference voltage which sets the operating point of the amplifier.

Any difference between the DC sample and the reference voltage appears at the collector of Q206 as an amplified and phase-inverted signal. The

signal from the collector of Q206 is again amplified and reversed in phase by Q202. The output of Q202 is coupled to emitter follower, Q201. The output from Q201 is the leveled B+ voltage supplied to the video amplifier.

2.5.4 Summary

Any change in RF output voltage is automatically corrected by the leveler circuit. Since a constant RF voltage is maintained at the monitor point, this point is a zero impedance, constant voltage point. Therefore, Z401 is the source impedance of the sweep generator.

The reference point in the ALC system, the base of Q207, is connected to the front panel RF vernier control. By adjusting this control, the operating point of the differential amplifier is changed, and the RF output level is changed.

Included within the unit is a switch, S201, which bypasses the internal monitor and connects the leveler circuit to a front panel external ALC input connector. This allows the unit to be leveled at a remote location if the user provides a detected monitor signal from the leveling point.

A sample of the RF output for use in the marker circuitry is coupled through R434 to the marker mixer. This sample of the swept signal is necessary for the production of markers in the birdie-bypass system.

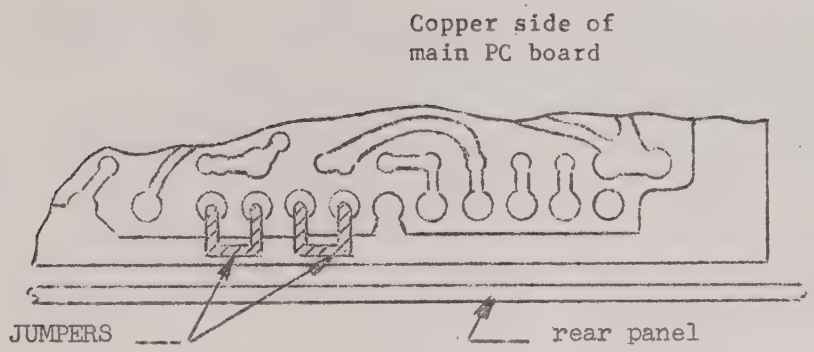
2.6 POWER SUPPLY

The DC power supply schematic diagram for the VS-50 is shown in Figure 6-1 of Section 6. The supply provides regulated +30V, +110V, and -30V sources, and a +50V unregulated power source. Power transformer, T1 can be wired for either 115V or 230V, 50/60 Hz input voltages. The units are normally wired for 115V, but may be changed to 230V operation by revising the jumper connections shown in Figure 2-2.

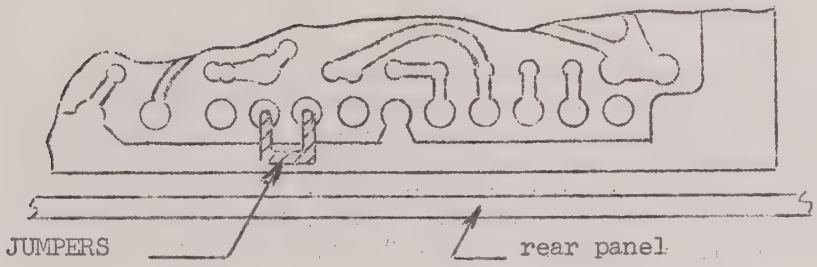
In addition to the DC outputs a 50/60 Hz line-sync signal is coupled from the secondary of T1 through R25 and zener diode VR8. This resistor-diode network reduces the effects of line voltage transients. The signal provides a constant output to synchronize the 50/60 Hz line sweep rate mode.

The unregulated +50V output is obtained from the fullwave rectifier CR2 and CR6, and an RC filter consisting of R1, C1C, and C2.

The +30 volt and the -30 volt regulated sources use complementary circuitry to provide the respective outputs. All diodes and polarized capacitors in the two sources are of the same respective types except the polarities are reversed. Q1 in the +30V supply is an NPN transistor, and its complement Q5 in the -30V supply is a PNP transistor.



115-VOLT CONNECTIONS



230-VOLT CONNECTIONS

NOTE:

Units shipped from the factory are identified for operation from the proper power source. Internal connections are made as shown for each input. Each input power source is identified as follows:

115-volt rms, 50/60 Hz, single-phase power
A YELLOW label marked "115V" is affixed to the power cord within six inches of the power plug, and to the rear panel of the instrument.

230-volt rms, 50/60 Hz, single-phase power
A RED label marked "230V" is affixed to the power cord within six inches of the power plug, and to the rear panel of the instrument.

FIGURE 2-2: 115-VOLT/230-VOLT INTERNAL CONNECTIONS

The +30 volt output is supplied by a series-type voltage regulator that uses pass transistor Q1. A constant-current source consisting of Q2, R2, R6, and breakdown diode VR1 provides a constant bias current to the base of pass transistor Q1 and to the collector of error amplifier Q4. The output voltage is sampled at R7, compared to the reference voltage across breakdown diode VR3 and temperature-compensating diode CR7, and the difference is amplified by Q4. Q4 drives pass transistor Q1, so that any change in output voltage is automatically corrected by a change in collector-to-emitter voltage of Q1 that restores the output voltage. R3 and Q12 protect the circuit from overload. As the output current reaches a preset value, the voltage across R3 increases causing Q4 to conduct. This action reduces the base drive to pass transistor Q1, and causes an increase in collector-to-emitter voltage of Q1 that limits load current. Output ripple of this supply is approximately 6 mV.

The +110 volt output is supplied by a series-type voltage regulator that uses pass transistor Q9 and driver transistor Q10. A constant-voltage source consisting of R16, R18, and breakdown diode VR7 supplies bias current to the base of Q10 and the collector of Q11. Gas discharge tube I2 provides the voltage reference for error amplifier Q11. Output ripple of this supply is approximately 6 mV.

2.7 MARKER CIRCUITRY

The unit is supplied with a birdie-bypass system (Figure 6-4 of Section 6), which has an external marker input plus provision for eight plug-in single frequency (SM) or harmonic (HM) markers. In the marker system, a sample of the swept RF signal is mixed with the fundamental or a harmonic of the plug-in markers to produce beatnotes or birdies. These beatnotes or birdies are then amplified, shaped, and superimposed upon the demodulated video signal and applied to the vertical channel of the oscilloscope.

The sweep sample from the video amplifier output is divided to provide two coupled signals to the marker circuitry. When an external CW source is used as a marker, the signal is coupled to mixer diode CR351 where it is mixed with the sweep sample from R355. The signal is then fed to the external marker amplifier Q306, a high-gain, common emitter amplifier.

R331 is a front panel external marker size control which allows the external marker system to accept a wide variation in signal source amplitudes.

The plug-in marker system consists of eight plug-in receptacles. Each plug-in receptacle has its own internal size adjustment. The markers produced in each plug-in can be independently controlled in amplitude with potentiometers R305, R306, R311, R312, R317, R318, R324, and R325.

This allows each marker to be adjusted to a different amplitude and gives quick and easy identification of the various markers on the oscilloscope display.

There are four amplifier stages built on the plug-in marker printed circuit board. Each amplifier stage is fed from two plug-in marker receptacles. The outputs of all four amplifier stages are fed through a common emitter amplifier, Q305. This plug-in marker signal and the external marker signal from Q306 are coupled to a common birdie amplifier stage which includes the marker shaper circuit consisting of C307, C308, C309, C310, C311, C315, C316, C317, L301, R334, R335, R342, and R343. This shaped marker is further amplified in Q307.

After amplification, the markers are applied to the marker size potentiometer, R339, which is a front panel adjustment, and become available at the oscilloscope vertical output connector on the front panel.

The connection of the sweep sample cables to the plug-in markers is shown in Figure 2-3.

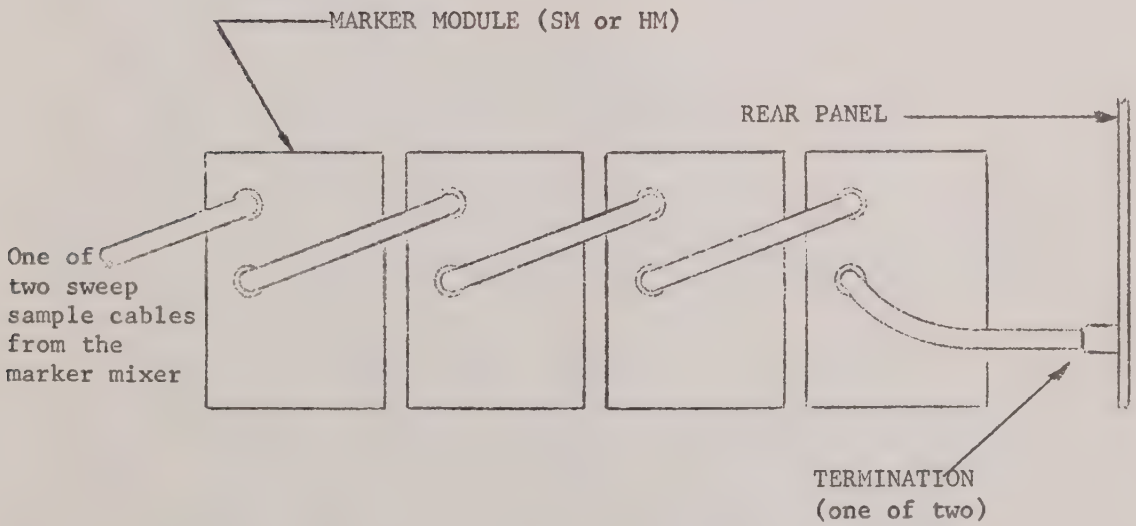


FIGURE 2-3

PLUG-IN MARKER HOOKUP
(ONE OF TWO ROWS SHOWN)

SECTION 3

OPERATING INSTRUCTIONS

3.1 INTRODUCTION

The VS-50 is a versatile, wide range sweep generator which incorporates the latest sweep techniques. It can be employed as a CW source as well as a sweep generator. Most of its operating features can be easily understood from a description of the front panel controls. This unit is supplied for operation from a 115 volt, 50/60 Hz power source, but can be supplied for 230 volt operation (See Figure 2-2).

3.2 DESCRIPTION OF FRONT PANEL CONTROLS and CONNECTORS

A drawing of the front panel of the VS-50 is shown in Figure 3-1. An identification of each control and its function is as follows:

3.2.1 Center Frequency Dial

Indicates the frequency of the output in the CW modes and at minimum sweep width in the sweep modes.

3.2.2 Power Switch

Switches on the line voltage to the unit.

3.2.3 External Marker Size Control

Provides adjustment of the amplitude of the external marker, if used.

3.2.4 Fixed Marker Size and Shaper

This dual control varies the size of all birdie markers, both plug-in SM or HM markers and external markers. The shaper can be used to vary the bandpass of the birdie amplifier, and, subsequently, narrow or widen the birdie marker width.

3.2.5 ALC Switch and RF Vernier

The ALC (automatic leveling control) switch can be used to switch from normal operation to external leveling. When in the EXT position, the RF level set potentiometers must be adjusted and an external monitor signal must be provided of sufficient amplitude or the unit will not meet its flatness specifications. The RF vernier provides continuously variable adjustment of the RF output level over a 6 dB range.

3.2.6 Attenuation

The rotary switch attenuators can be used to control the amplitude of the RF output by as much as 80 dB in 1 dB increments.

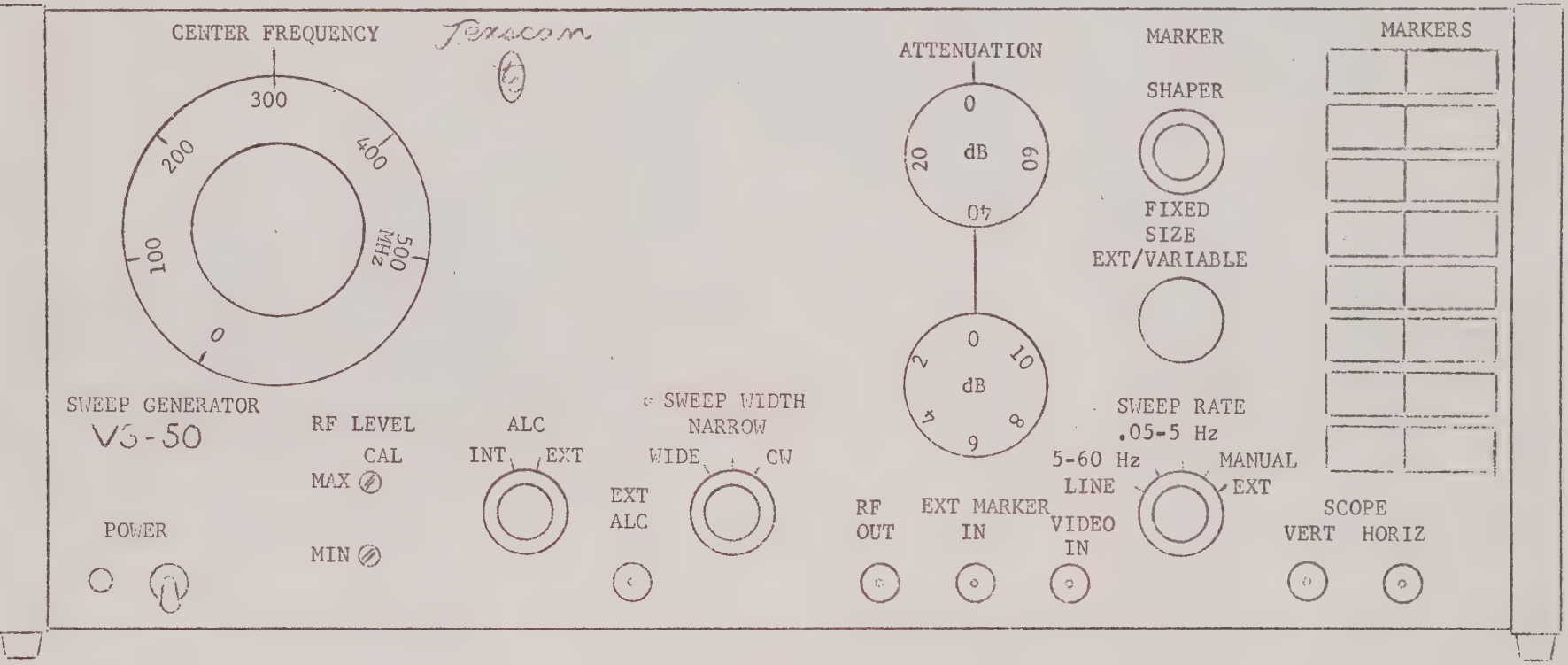


FIGURE 3-1

VS-50 FRONT PANEL

3.2.7 Sweep Width Control

This potentiometer and switch combination is used to vary sweep width of the output and to select the CW mode of operation.

3.2.8 Sweep Rate Control

This potentiometer and switch combination provides control of the rate at which the RF output is swept. Five modes are provided: (1) Line; 50/60 Hz sweep rate, (2) Variable; 5 to 60 Hz continuously variable, (3) Variable; 0.05 to 5 Hz continuously variable, (4) Manual; center knob can be used to manually sweep the unit, and (5) External; an external source may be employed to sweep the RF oscillator.

3.2.9 Marker Switches

These switches are used to turn on or off any plug-in markers employed.

3.2.10 RF Out Connector

Connector for swept or CW output.

3.2.11 External Marker Connector

This connector allows an external signal source to be inserted to provide a marker on the video output.

3.2.12 Video In Connector

The detected RF from the device under test is inserted here to superimpose birdie markers on the detected signal.

3.2.13 Scope Vertical

The detected RF signal with markers superimposed is available at this connector for connection to the oscilloscope vertical channel.

3.2.14 Scope Horizontal

The oscilloscope horizontal drive signal is available at this connector.

3.2.15 RF Level Set Potentiometers

Two potentiometers are provided on the front panel to set the maximum and minimum output power levels which can be obtained by varying the RF vernier control. These potentiometers are set at the factory for proper operation with the internal monitor system. They are provided as front panel controls so that if an external monitor is employed, these levels can be reset.

3.2.16 External ALC Connector

The monitor signal from an external monitor, if used, is inserted here.

3.3 DESCRIPTION OF REAR PANEL CONNECTORS

3.3.1 External Drive

A sweep drive signal from an external source may be inserted here.

3.4 TYPICAL TEST SETUP

For a typical test application, make connection to the oscilloscope, device under test, detector, and sweep generator as shown in Figure 3-2.

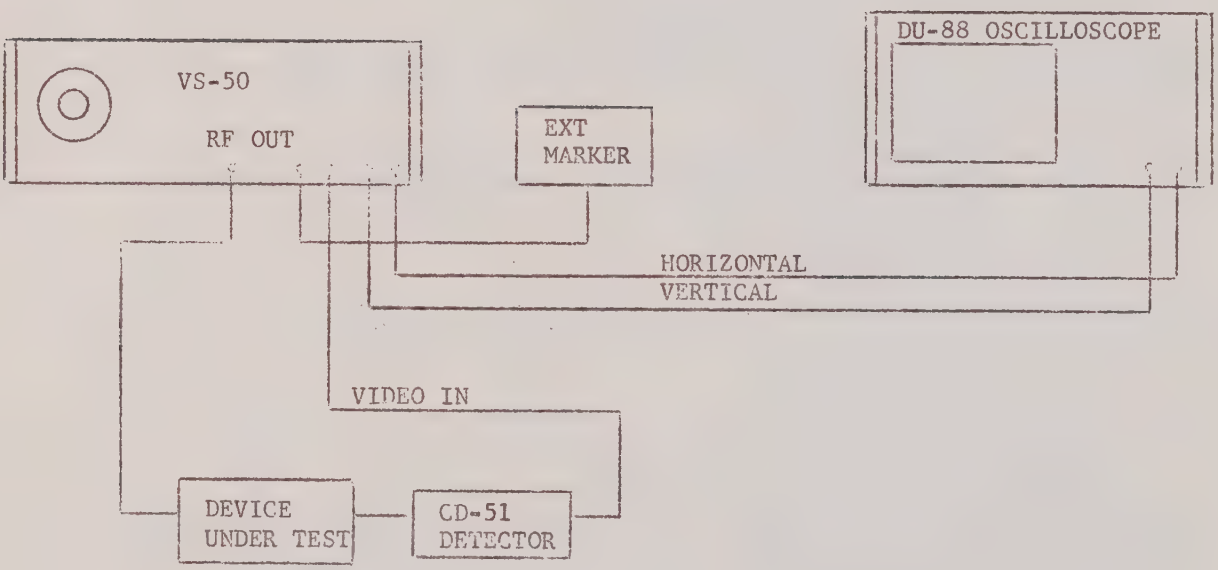


FIGURE 3-2

TYPICAL TEST SETUP

This is the setup for measurement of bandpass characteristics and is the most widely used application for sweep generators.

SECTION 4

ADJUSTMENT PROCEDURE

4.1 INTRODUCTION

The adjustments and test of this instrument can be accomplished with the following test equipment; an oscilloscope (such as HP-130), a VTVM, and a multimeter. It is suggested that the operator become familiar with the circuit operation in Section 2 before attempting alignment of this instrument. Test of the instrument for spurious level and harmonic distorttion requires a spectrum analyzer such as the Texscan AL-60.

Paragraph 4.2 gives a discussion of the internal controls which require identification during alignment of the unit. Subsequent sections describe in detail the alignment procedure for each circuit. All internal controls are properly adjusted at the factory and only minor adjustments should be required in the field due to aging or changing of components.

4.2 EXPLANATION OF INTERNAL CONTROLS

Refer to Figure 6-5 to identify the location of each of the following controls:

4.2.1 R7, +30 Volt Adjust

Adjusts the output voltage of the +30V power supply.

4.2.2 R14, -30 Volt Adjust

Adjusts the output voltage of the -30V power supply.

4.2.3 R21, +110 Volt Adjust

Adjusts the output voltage of the +110V power supply.

4.2.4 R101, Upper Trigger Point Adjust

Adjusts the upper trigger point for the Schmitt Trigger in the rate generator.

4.2.5 R106, Line DC Level Adjust

Adjusts the DC level of the rate generator output voltage in the line rate mode of operation so that it is equal to the DC level in the variable rate mode.

4.2.6 R108, Lower Trigger Point Adjust

Adjusts the lower trigger point for the Schmitt Trigger in the rate generator.

4.2.7 R119, Line Trigger Amplitude Adjust

Adjusts the amplitude of the rate generator output voltage in the line rate mode of operation so that it is equal to the amplitude in the variable rate mode.

4.2.8 R128, Linearity Drive Level Adjust

Adjusts the DC level of the linearity drive voltage.

4.2.9 R131, Linearity Drive Size Adjust

Adjusts the amplitude of the linearity drive voltage.

4.2.10 R138, Varactor Drive Size Adjust

Adjusts the amplitude of the drive signal as provided by transistor stages, Q106 and Q107. R138 and R131 are both sweep width limit potentiometers, but they have different effects on linearity.

4.2.11 R141, Linearity Adjustment

This control is adjusted to vary the shape of the sweep drive waveform for one sweep oscillator.

4.2.12 R157, Linearity Adjustment

This control is adjusted to vary the shape of the sweep drive waveform for the second sweep oscillator.

4.2.13 R163, Low Frequency Calibration Adjust

Sets the low frequency limit of the calibrated frequency range.

4.2.14 R167, High Frequency Calibration Adjust

Sets the high frequency limit of the calibrated frequency range.

4.2.15 R305,R306,R311,R312,R317,R318,R324,R325-Marker Size Adjust

These controls provide individual adjustment of the marker size available from plug-in marker receptacles one through eight.

4.2.16 S102, Blanking Selector Switch

Provides the choice of video blanking (normal) or RF blanking.

4.3 POWER SUPPLY

4.3.1

With the polarized plug of the unit connected to the AC power line, and the power switch on, monitor the -30V DC point with an accurate voltmeter and a high gain, AC coupled oscilloscope at the cathode (band) of VR5.

4.3.2

Adjust R14, the -30 volt adjust potentiometer for a -30 volt level. The AC ripple, as viewed on the scope should be approximately 6 mV peak to peak.

4.3.3

Connect the meter and scope to the anode of VR2, and adjust R7 for a +30 volt DC level. The ripple should be approximately 6 mV peak-to-peak.

4.3.4

Connect the meter and scope to the anode of VR7, and adjust R21 for a +110 volt DC level. The ripple should be approximately 6 mV peak-to-peak.

4.4 RATE GENERATOR

4.4.1

To align the rate generator, perform the following operations:

4.4.1.1

Connect the oscilloscope and a negative output RF detector as indicated in Figure 3-2, but omit the device under test.

4.4.1.2

Set the sweep rate function switch (S103) to manual position.

4.4.1.3

Turn the sweep rate vernier control (R120), from one extreme to the other. Adjust the horizontal gain and horizontal position controls of the oscilloscope so the dot on the CRT centers on the extreme left-hand side, vertical reticule when the sweep rate vernier control is in the fully counterclockwise position; and on the extreme right-hand, vertical reticule, when the potentiometer is in the fully clockwise position. This change should be approximately -7V to +7V, and minimum of -5V to a minimum of +5V.

4.4.1.4

Set the sweep rate function switch (S103) to either of the variable positions.

4.4.1.5

The dot should be viewed on the oscilloscope as drawing a rectangular pattern. Adjust the lower trigger point control (R108) so that the lower left-hand corner of the rectangle falls on the extreme left-hand vertical reticule. Adjust the upper trigger point control (R101) so that the lower right-hand corner of the rectangle falls on the extreme right-hand vertical reticule. There is some interaction between these two controls and it will be necessary to "rock" in the adjustments by alternately adjusting R101 and R108 until the proper display is obtained.

4.4.1.6

Set the sweep rate function switch (S103) to line position.

4.4.1.7

Adjust the line trigger amplitude control (R119) and the line DC level control (R106) until the same pattern as noted in 4.4.1.5 is obtained. It will be noted that these two controls also interact with one another.

4.4.1.8

If any of the steps cannot be completed, refer to Section 5 for trouble shooting procedures.

4.5 LINEARITY CIRCUIT

4.5.1

The linearity and sweep width of this unit can be adjusted by performing the following operations.

4.5.2

Connect the unit to the oscilloscope as indicated in the typical test set-up, Figure 3-2, but omit the device under test.

4.5.3

The best method to use when adjusting sweep width and linearity requires a 50 MHz harmonic marker (HM-50). If another harmonic marker is available, it can be employed with note taken of the changes required in the following procedure.

4.5.4

Adjust the scope horizontal gain for 10 cm horizontal deflection. If a 50 MHz harmonic marker is used, center the 250 MHz marker on the scope display while the unit is at reduced sweep width with the center frequency dial.

4.5.5

Advance the sweep width potentiometer (front panel control) to full sweep width and note any position change of the 250 MHz birdie marker. If there is any shift, adjust the linearity drive level control (R128) until the 250 MHz marker is at the center of the sweep.

4.5.6

With the sweep width set at maximum, there should be 10 markers present on the scope trace with one centimeter intervals from 0 to 500 MHz. If the sweep width is too narrow or too wide, adjust R131, linearity drive size, for the proper 500 MHz sweep width.

4.5.7

The resistor values (R142 through R156) in the varactor drive circuit are factory selected to give the best linearity and only two linearity adjustments are provided (R141, LIN 1 and R157, LIN 2). These controls interact and should be "rocked in" to obtain the best linearity.

4.5.8

Adjust the center frequency control so that zero frequency is at the reticule furthest to the left and 500 MHz at the furthest reticule to the right.

4.5.9

Adjust LIN 1 and LIN 2 until the 50 MHz markers occur as close to the reticule lines as possible. If linearity is adjusted perfectly, the 50 MHz

markers will occur precisely at the reticule lines all across the display. If the markers occur within 0.1 cm of the reticule lines, the unit is meeting its linearity specifications. The linearity specification requires that the relationship between output frequency and time will be within one percent when referenced to a straight line function.

4.5.10

When properly aligned, the oscilloscope presentation will be as shown in Figure 4-1.

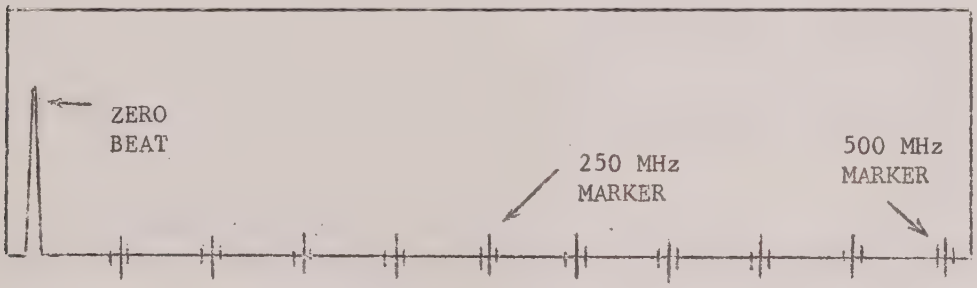


FIGURE 4-1

LINEARITY DISPLAY
USING 50 MHz HARMONIC MARKERS

4.5.11

If it is not possible to set linearity with the adjustments in 4.5.8 and 4.5.9, it may be necessary to readjust varactor drive size (R138). R138 changes the sensitivity of the linearity adjustments so that after varying R138, steps 4.5.8 and 4.5.9 should be repeated.

4.5.12

Check the frequency dial calibration as indicated by proper centering of frequency markers at minimum sweep width. If the dial calibration is off, make the following adjustments:

4.5.12.1

Adjust the frequency dial to zero frequency and reduce the sweep width to minimum. Adjust low frequency calibrate (R163) until the zero frequency presentation stays centered on the display as the sweep control is varied from maximum to minimum.

4.5.12.2

Adjust the center frequency dial to 500 MHz and adjust high frequency calibrate (R167) until the 500 MHz marker remains centered in the middle of the trace as the sweep width control is reduced to zero.

4.5.13

There is some interaction between low frequency calibrate (R163) and high frequency calibrate (R167) and it will be necessary to repeat steps 4.5.12.1 and 4.5.12.2 several times until the adjustments are properly set.

4.6 RF LEVEL ADJUSTMENT

4.6.1

With the same setup as used in paragraph 4.5, set the RF level vernier for maximum output.

4.6.2

Being certain that the monitor switch is set for internal monitoring, adjust the maximum level potentiometer for 1.15V detected output level using a CD-51 as noted from the oscilloscope calibrated display.

4.6.3

Switch in 6 dB of attenuation and note the vertical deflection on the oscilloscope.

4.6.4

Rotate the RF level vernier for minimum output, remove the 6 dB of attenuation, and adjust the minimum level potentiometer for the same level of detected output as noted in 4.6.3.

4.6.5

There is some interaction between these two adjustments and steps 4.6.2 and 4.6.4 may have to be repeated before the range on the RF level control is properly adjusted.

4.7 MARKER SIZE

4.7.1

Individual marker size controls are provided, as well as the front panel control, so that if a complicated set of markers are employed, their relative sizes can be set for easy identification.

4.7.2

For example, if 50 MHz, 10 MHz, and 1 MHz harmonic markers are all used, adjust the internal control for the HM-50 for 0.2 volt birdies, the HM-10 for 0.1 volt, and the HM-1 for 0.05 volt producing an easily identified display.

4.8 SWEEP OSCILLATORS, MIXER, AND VIDEO AMPLIFIER

These circuits are such that adjustment of internal controls to realign is impractical. They are designed to require no adjustment in the field. These circuits should only be investigated when trouble shooting procedures have isolated a problem to these areas.

4.9 SPURIOUS CONTENT AND HARMONIC DISTORTION

The best way to measure spurious and harmonic content of the VS-50 is with a spectrum analyzer such as the Texscan AL-60.

4.9.1

Set the SWEEP WIDTH switch to CW, and turn off all markers on the VS-50.

4.9.2

Couple the RF OUT connector of the VS-50 to the RF input of the spectrum analyzer.

4.9.3

Set the spectrum analyzer controls to display RF signal amplitude in the frequency domain.

4.9.4

Set the VS-50 to the test frequency.

4.9.5

Calibrate the spectrum analyzer display.

4.9.6

Adjust the frequency of the spectrum analyzer, and observe the spurious response of the VS-50. Any spurious signals should be at least 25 dB below the fundamental frequency of the unit. See Figure 4-2.

4.9.7

Adjust the frequency of the spectrum analyzer to display multiples of the fundamental frequency of the unit. Observe the harmonics as shown in Figure 4-3 to be at least 25 dB below the fundamental frequency of the VS-50.

SECTION 5

MAINTENANCE

5.1 INTRODUCTION

In trouble shooting electronic equipment, the best approach is to systematically isolate the problem to a particular circuit, and then to a component by a process of elimination. Before attempting to locate a failure, it is suggested that the trouble shooting technician or engineer become familiar with the equipment by reading Sections 2 and 3 of this manual. The following paragraph, paragraph 5-2, presents a trouble shooting chart which lists some of the common failures. This trouble shooting chart should assist in finding or localizing the defective part. A VTVM and an oscilloscope should be sufficient to test the unit.

5.2 TROUBLE SHOOTING CHART

SYMPTOM	CHECK
5.2.1	
Power switch on, but the pilot light does not come on	F1.
5.2.2	
F1 blows when the unit is turned on.	C1A, C1B, C1C, C1D, C2, C7,CR1,CR2, CR3,CR4,CR5,CR6,T1.
5.2.3	
+30V not present or has excessive ripple.	C1D,C4,C5,C6,CR2,CR6,CR7,CR8,Q1 Q2,Q3,Q4,Q12,VR1,VR3.
5.2.4	
-30V not present or has excessive ripple.	C7,C8,C9,C10,CR3,CR5,CR9,CR10,Q5, Q6,Q7,Q8,Q13,VR4,VR6.
5.2.5	
+110V not present or has excessive ripple.	C1A,C1B,C13,C14,C15,C16,Q9,Q10, Q11,I2,VR7.
5.2.6	
+50V not present, but +30V normal.	C1D, C2, R1.

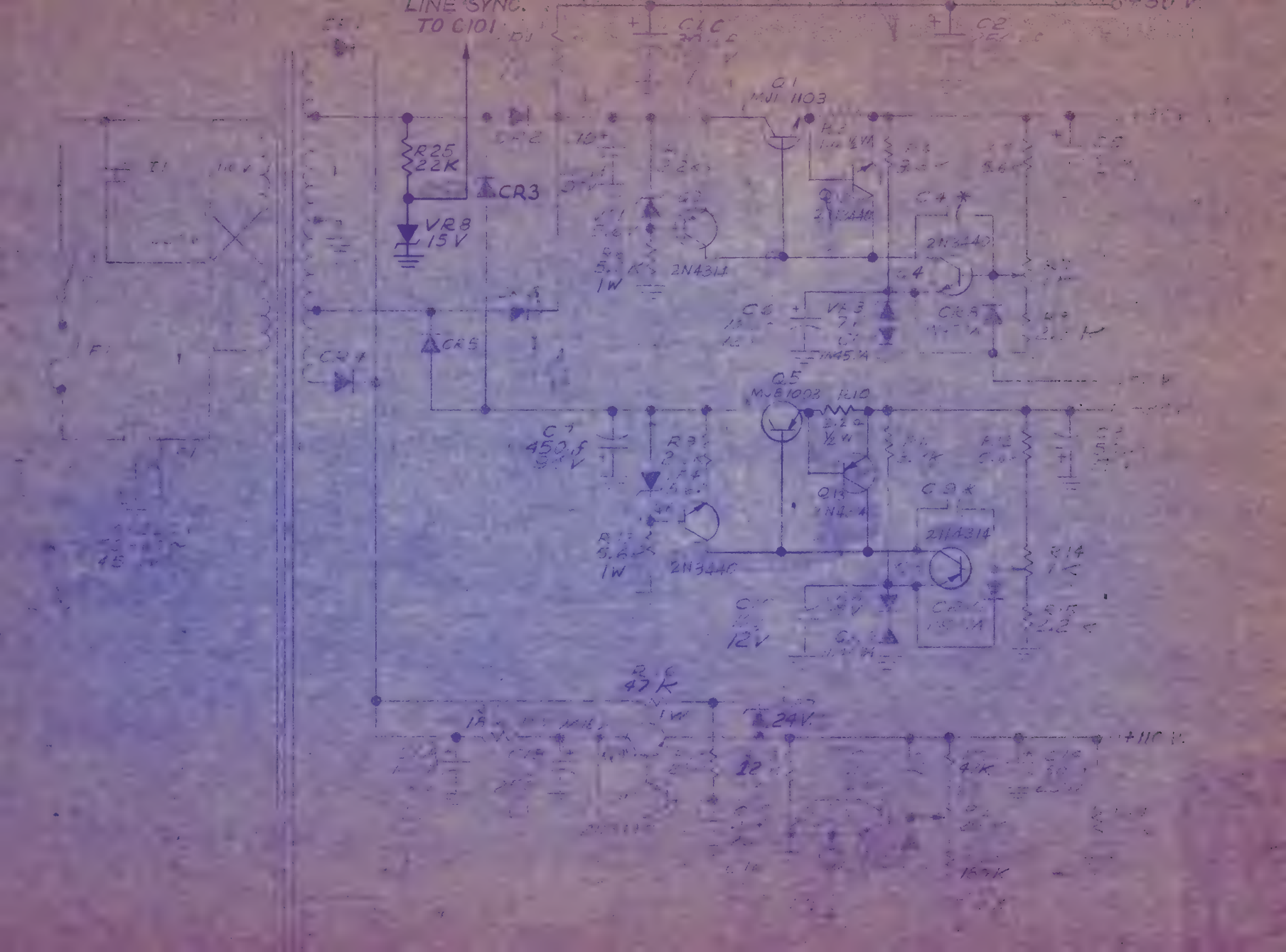
5.2.7	
Power supply voltages will not adjust properly.	Zener diodes in respective supplies, or I2 in +110V supply.
5.2.8	
No horizontal drive, but manual sweep operates normally.	Q101,Q102,Q103,Q104.
5.2.9	
No horizontal drive in any sweep rate position.	Q101,Q102,Q103,Q104,Q105.
5.2.10	
Horizontal drive normal, but no RF blanking.	Q203,Q204.
5.2.11	
Horizontal drive normal, but no video blanking.	Q109.
5.2.12	
Center frequency does not adjust.	+110V supply, Q106,Q107.
5.2.13	
RF output will not level properly.	Max RF level control, R210 improperly set. CR401,Q201,Q202,Q206, Q207.
5.2.14	
Insufficient or no RF output.	Q501,Q502,Q401,Q402,Q403,Q404; +30 volt supply, -30 volt supply, +50 volt supply.
5.2.15	
No internal or external markers.	Q307.
5.2.16	
Internal markers normal, but external markers inoperative.	CR351,Q306.
5.2.17	
Some internal markers normal, others inoperative, external marker normal.	Transistor for respective marker. Plug-in markers.

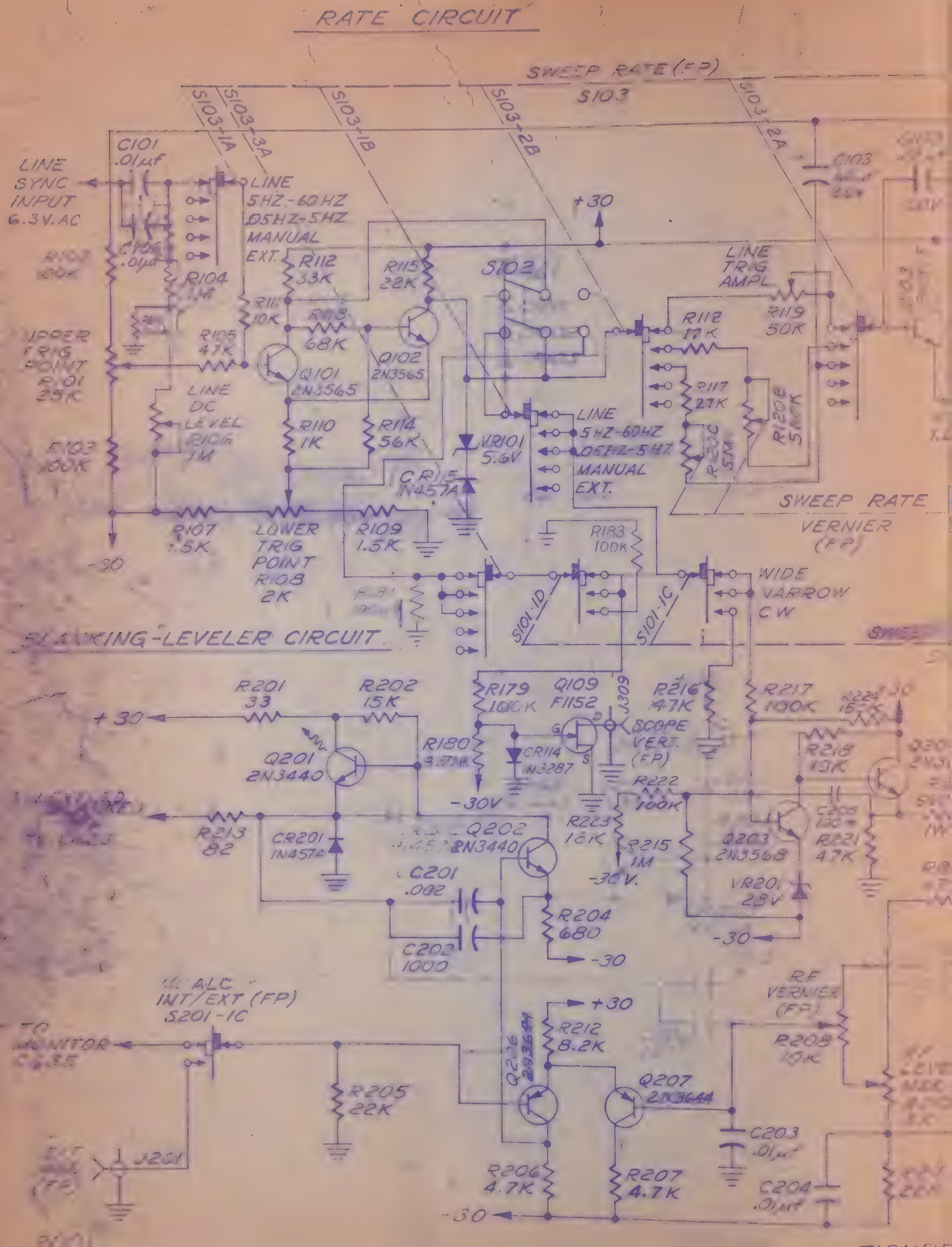
5.2.18

External marker normal, but no internal markers. Q305.

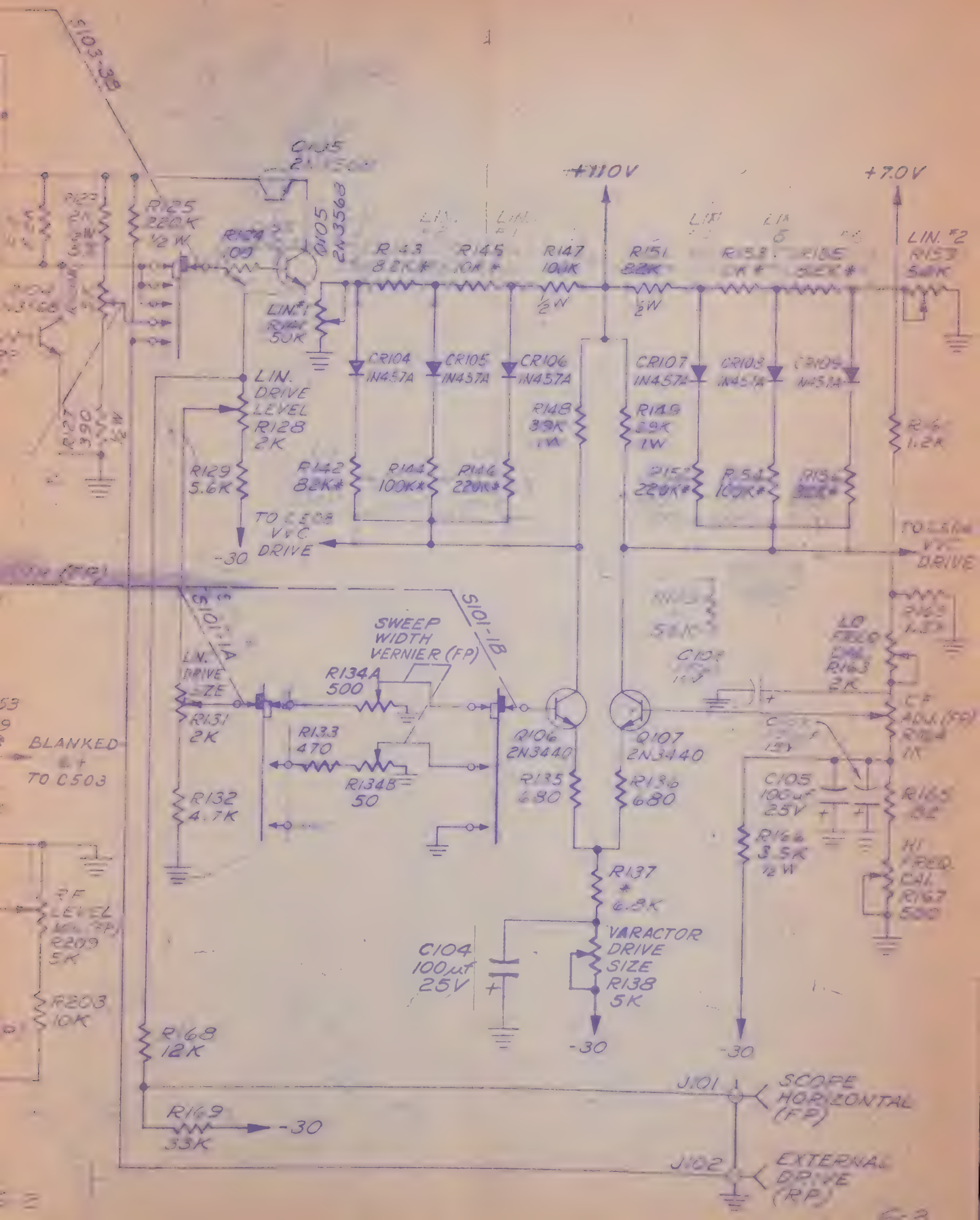
SECTION 6

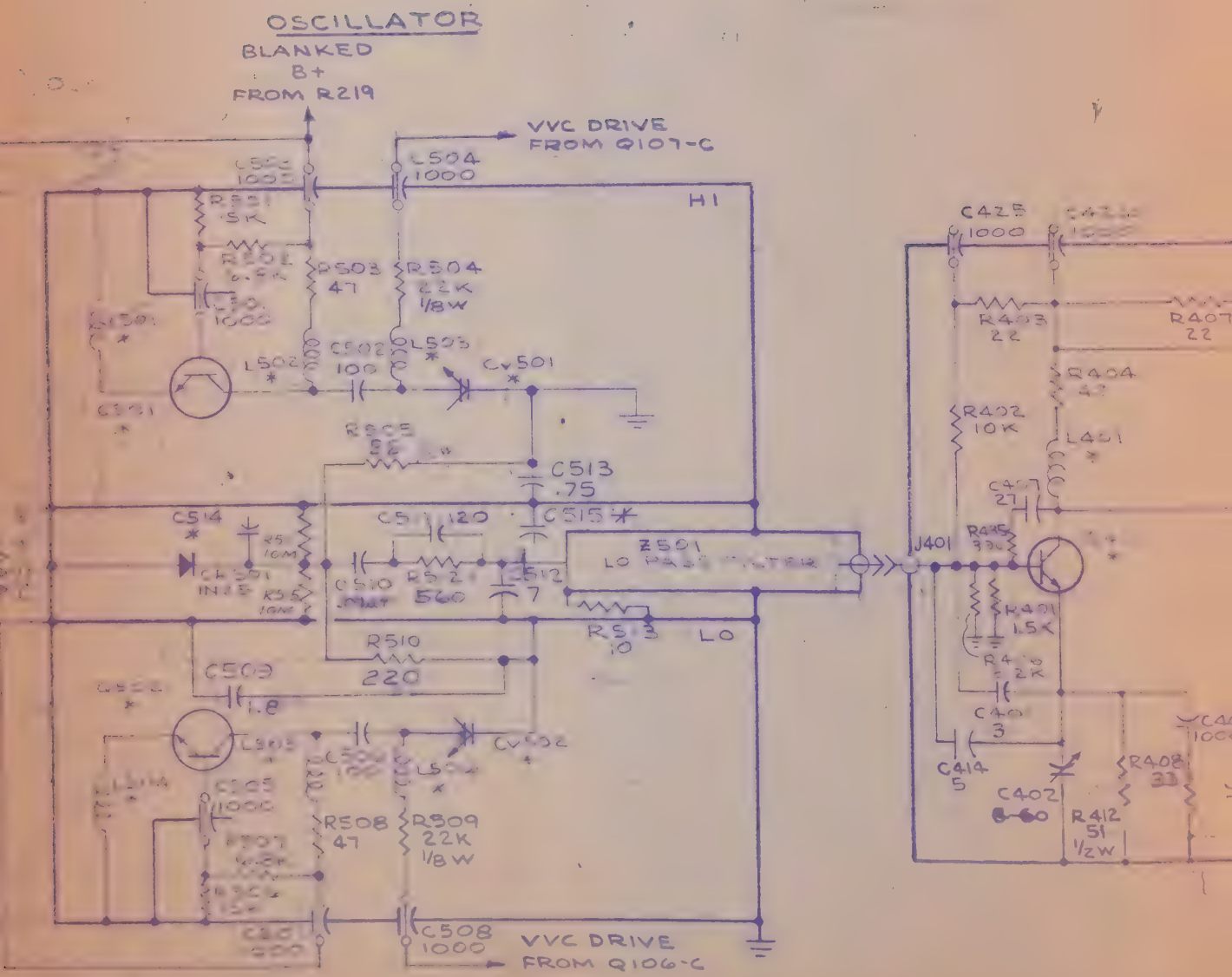
DOCUMENTATION


LINE SYNC.
TO C101
Q1
MJI 1103
R25
22K
CR3
VR8
15V
2N4314
Q5
MJE1003
Q13
2N4314
2N3440
12V
24V
47K
1W
5.6K
1W
450 µf
12
+110 V.

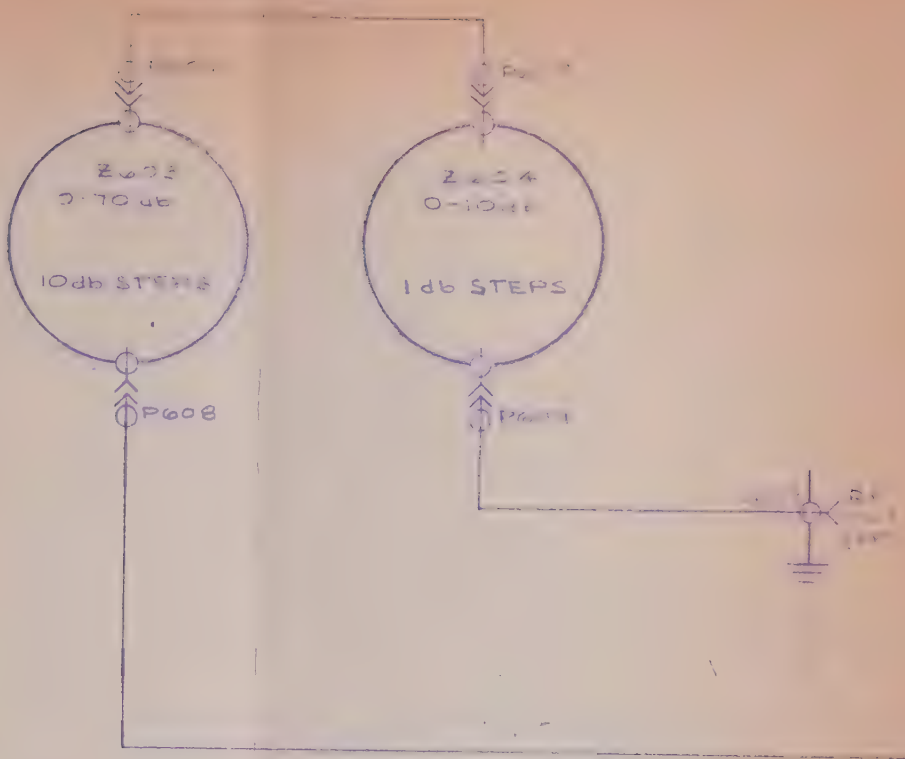

RATE CIRCUIT
SWEEP RATE (F.P.)
S103
S103-1A
S103-3A
S103-1B
S103-2B
S103-2A
C101 .01μf
LINE SYNC INPUT 6.3V.AC
LINE 5HZ-60HZ .05HZ-5HZ MANUAL EXT.
R104 1M
R112 33K
R115 22K
S102
+30
LINE TRIG AMPL
R119 50K
R118 11K
R117 27K
R120B 5M
R120C 5M
C103
R111 10K
R113 68K
Q102 2N3565
Q101 2N3565
R105 47K
UPPER TRIG POINT R101 25K
LINE DC LEVEL R106 1M
R110 1K
R114 56K
VR101 5.6V
CR115 IN457A
LINE 5HZ-60HZ .05HZ-5HZ MANUAL EXT.
SWEEP RATE VERNIER (F.P.)
R103 100K
R107 1.5K
LOWER TRIG POINT R108 2K
R109 1.5K
-30
R183 100K
S101-1D
S101-1C
WIDE VARROW CW
BLANKING-LEVELER CIRCUIT
R201 33
R202 15K
+30
R179 100K
Q109 F1152
J309
R216 47K
R217 100K
R224 15K
SCOPE VERT. (F.P.)
Q201 2N3440
R180 4.7K
CR114 IN3287
-30V
R218 15K
R213 82
CR201 IN457A
Q202 2N3440
R223 16K
R222 100K
R215 1M
-30V.
Q203 2N3568
C206 10μf
R221 4.7K
VR201 29V
C201 .002
C202 1000
R204 680
-30
ALC INT/EXT (F.P.) S201-1C
TO MONITOR
+30
R212 8.2K
RF VERNIER (F.P.)
R209 10K
R205 22K
Q206 2N3644
Q207 2N3644
C203 .01μf
J201
R206 4.7K
R207 4.7K
C204 .01μf
-30

LINEARITY CIRCUIT

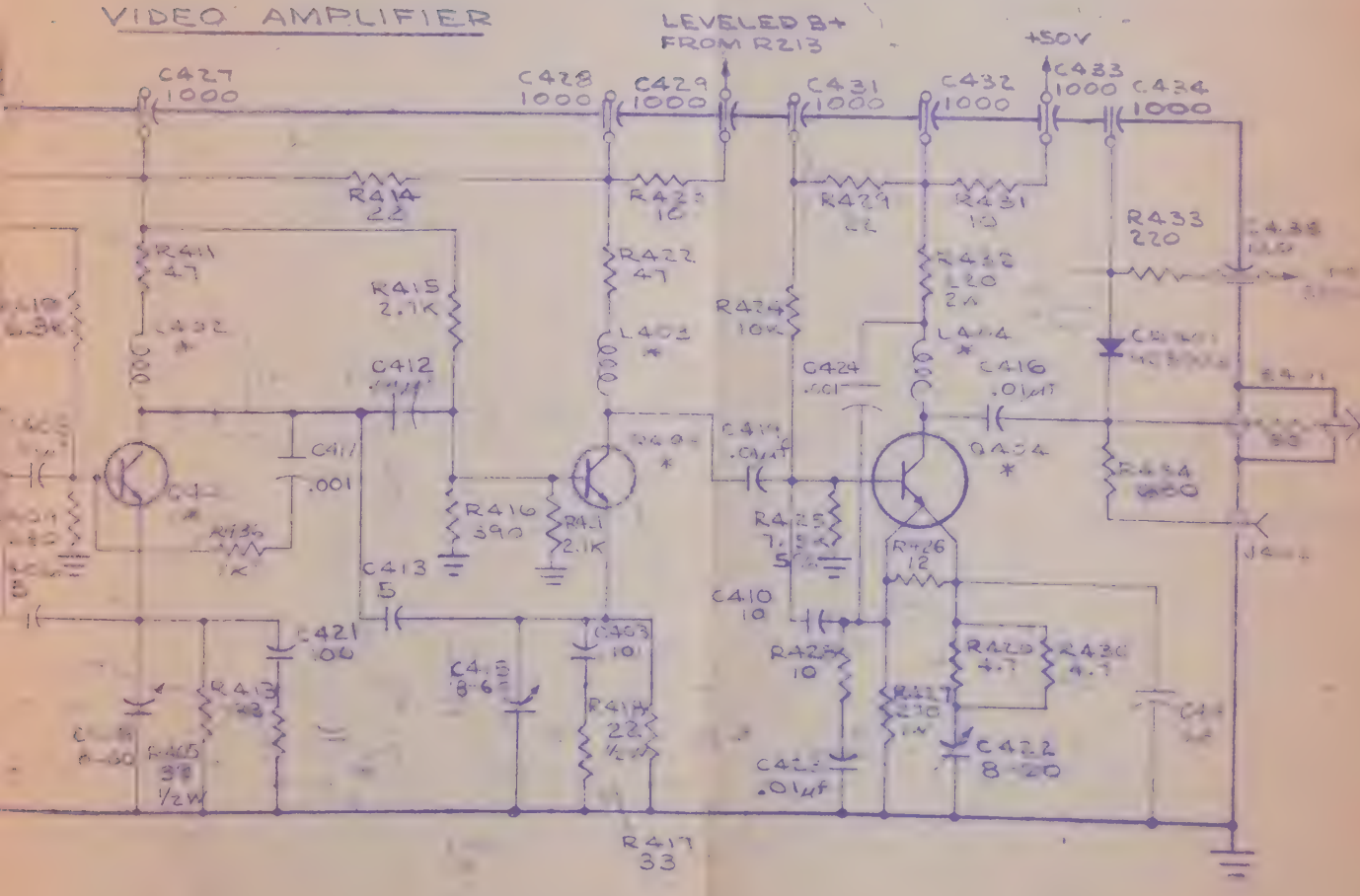


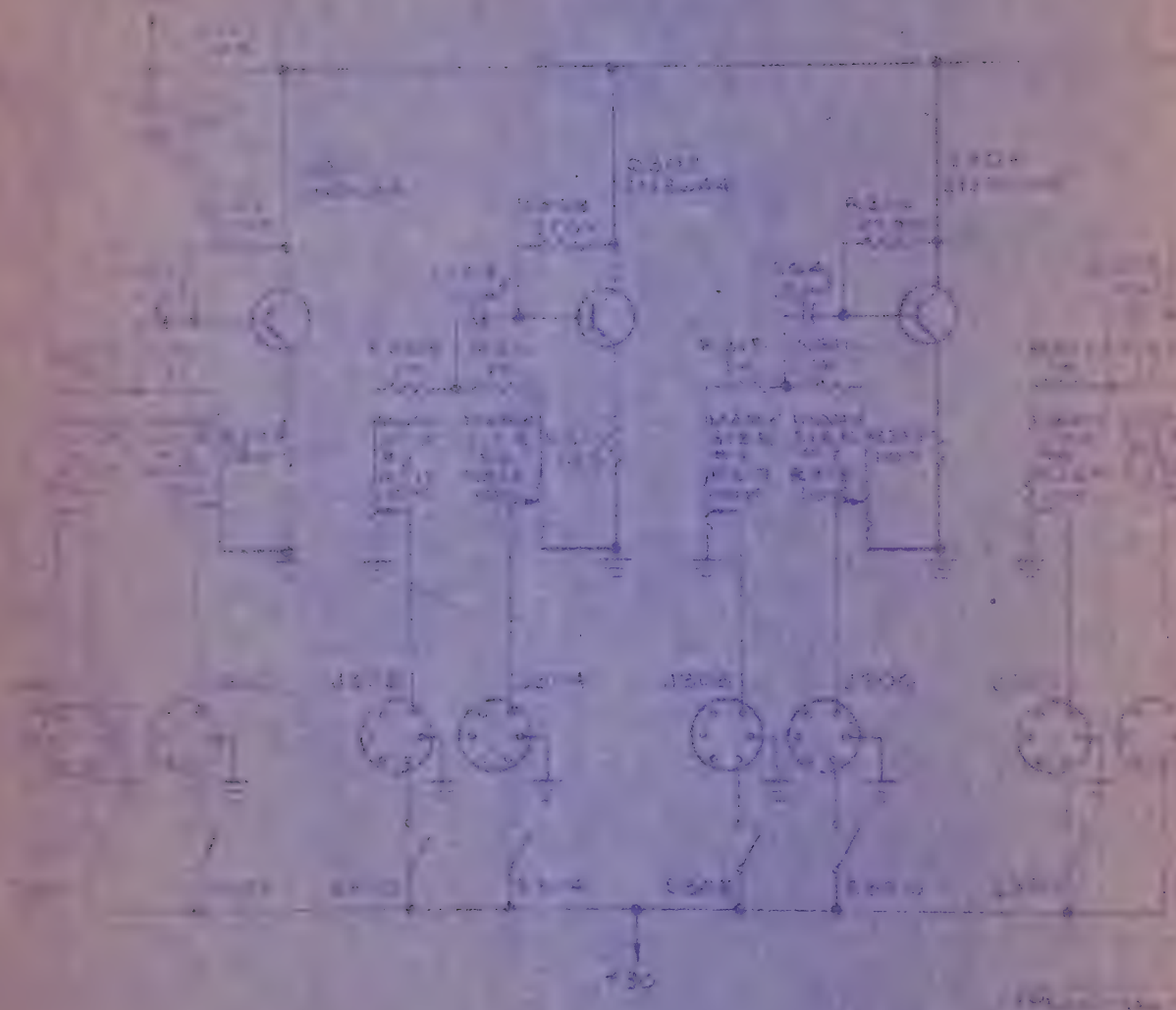

OSCILLATOR
BLANKED
B+
FROM R219
VVC DRIVE
FROM Q107-C
L504
1000
H1
R503
47
R504
22K
1/8W
C502
100
L503
L502
Cv501
C513
.75
C514
C515
120
Z501
J401
R510
220
C509
1.8
R508
47
R509
22K
1/8W
C508
1000
VVC DRIVE
FROM Q106-C
C425
1000
R403
22
R404
47
R402
10K
L401
C407
27
R405
R401
1.5K
C403
3
C414
5
C402
R412
51
1/2W
R408
33
LO

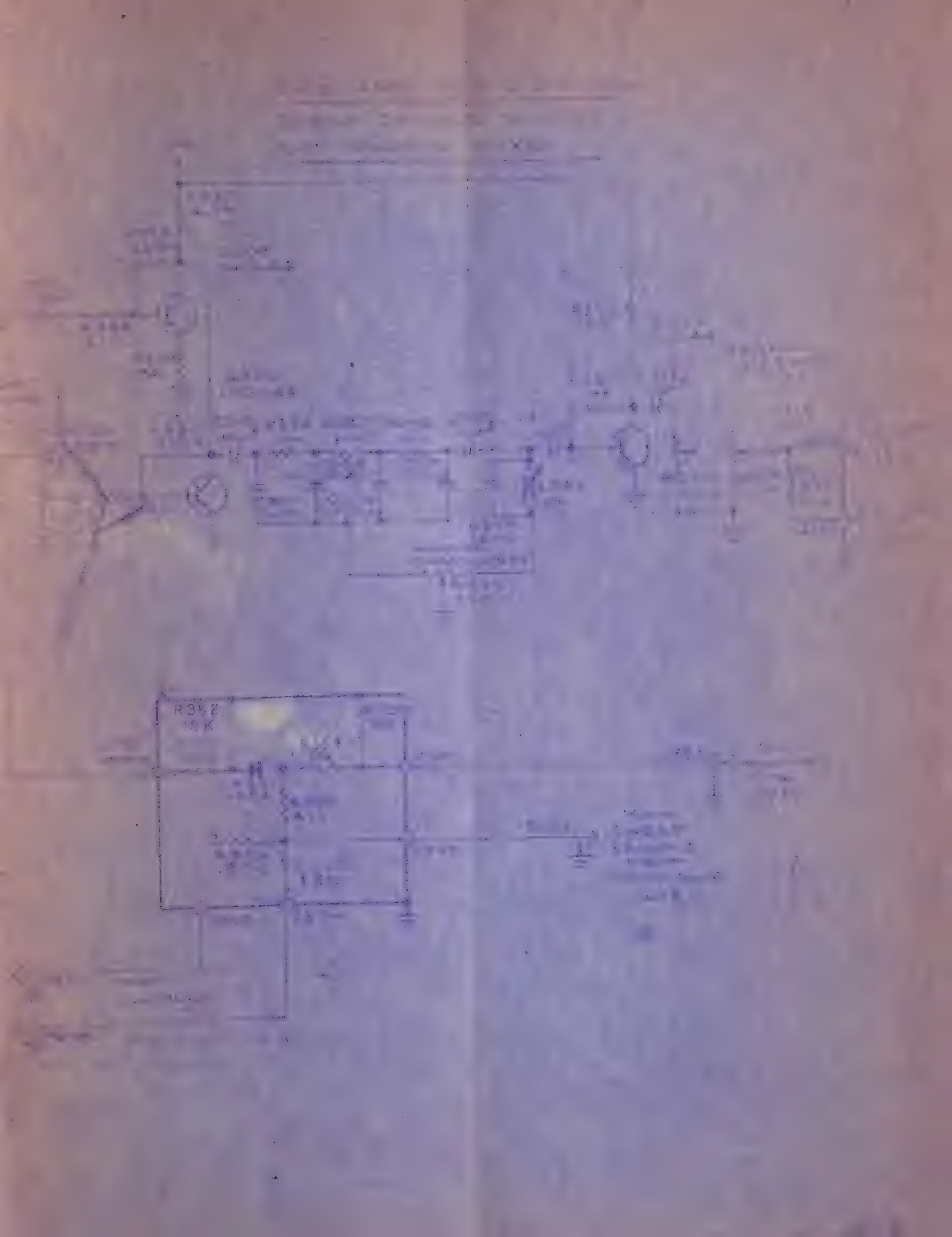
FIGURE

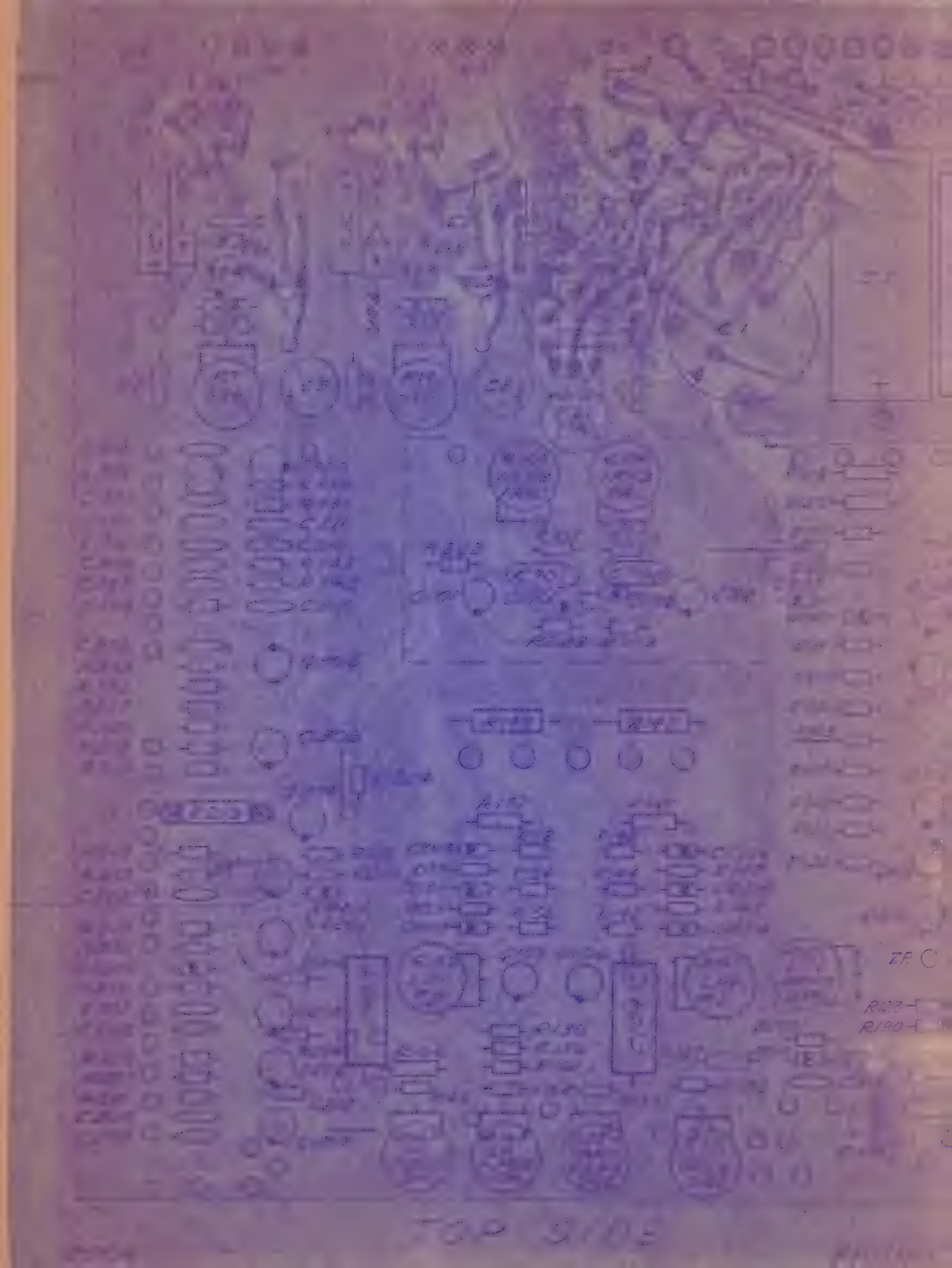


VIDEO AMPLIFIER






R352
14K



NOTES:

1. X TERMINALS
OP SIDE.
2. TERMINAL
CONNECTION

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION
		CAPACITORS
C1A,C1B, C1C,C1D	012-221	100uF, 300V; 80uF, 250V; 30uF, 150V; 300uF, 90V
C2	012-223	250uF, 75V
C4		Factory Selected
C5	012-082	50uF, 50V
C6	012-015	100uF, 12V
C7	012-222	450uF, 90V
C8	012-082	50uF, 50V
C9		Factory Selected
C10	012-015	100uF, 12V
C13	012-023	0.1uF, 200V
C14	012-225	50uF, 250V
C15	012-023	0.1uF, 200V
C16	012-024	.22uF, 200V
C101	012-066	0.01uF, 100V
C102	012-020	0.22uF, 100V
C103	012-155	1.5uF, 35V
C104	012-016	100uF, 25V
C105	012-016	100uF, 25V
C106	012-066	0.01uF, 100V
C107	012-113	350uF, 15V
C108	012-113	350uF, 15V
C201	012-163	0.002uF, 1000V
C202	012-009	1000pF, 500V
C203	012-050	0.01uF, 100V
C204	012-050	0.01uF, 100V
C205		Factory Selected
C301	012-050	0.01uF, 100V
C302	012-050	0.01uF, 100V
C303	012-050	0.01uF, 100V
C304	012-050	0.01uF, 100V
C305	012-050	0.01uF, 100V
C306	012-050	0.01uF, 100V
C307	012-009	1000pF, 500V
C308	012-009	1000pF, 500V
C309	012-009	1000pF, 500V
C310	012-050	0.01uF, 100V
C311	012-050	0.01uF, 100V
C312	012-050	0.01uF, 100V
C313	012-050	0.01uF, 100V
C314	012-013	120pF, 1000V
C315	012-050	0.01uF, 100V
C316	012-009	1000pF, 500V
C317	012-009	1000pF, 500V
C351	012-001	1000pF, Feedthru
C401	012-010	3pF, 1000V
C402	015-009	8-60pF Variable
C403	012-011	10pF, 1000V
C404	012-068	100pF, 1000V
C405	012-050	0.01pF, 100V

Capacitors continued

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION
C406	012-092	5pF, 1000V
C407		Factory Selected
C408	015-009	8-60pF Variable
C410	012-011	10pF, 1000V
C412	012-050	0.01uF, 100V
C413	012-092	5pF, 1000V
C414	012-092	5pF, 1000V
C415	015-009	8-60pF Variable
C416	012-005	0.01uF, 500V
C417	012-009	1000pF, 500V
C418	012-031	68pF, 1000V
C419	012-005	0.01uF, 500V
C421	012-068	100pF, 1000V
C422	015-009	8-60pF Variable
C423	012-050	0.01pF, 100V
C424	012-009	1000pF, 500V
C425	012-037	1000pF, Standoff
C426	012-037	1000pF, Standoff
C427	012-037	1000pF, Standoff
C428	012-037	1000pF, Standoff
C429	012-001	1000pF, Feedthru
C431	012-037	1000pF, Standoff
C432	012-037	1000pF, Standoff
C433	012-001	1000pF, Feedthru
C434	012-001	1000pF, Feedthru
C435	012-058	120pF, Feedthru
C501	012-001	1000pF, Feedthru
C502	012-118	100pF, 300V
C503	012-001	1000pF, Feedthru
C504	012-001	1000pF, Feedthru
C505	012-001	1000pF, Feedthru
C506	012-118	100pF, 300V
C507	012-001	1000pF, Feedthru
C508	012-001	1000pF, Feedthru
C509	012-070	1.8pF, 500V
C510	012-050	0.01uF, 100V
C511	012-150	120pF, 1000V
C512	012-057	7pF, 500V
C513	012-056	0.75pF
C514		Factory Selected
C515		Factory Selected

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION
		DIODES
CR1	025-044	E-8
CR2	025-007	E-4
CR3	025-007	E-4
CR4	025-044	E-8
CR5	025-007	E-4
CR6	025-007	E-4
CR7	025-034	1N457A
CR8	025-034	1N457A
CR9	025-034	1N457A
CR10	025-034	1N457A
CR11	025-034	1N457A
CR104	025-034	1N457A
CR105	025-034	1N457A
CR106	025-034	1N457A
CR107	025-034	1N457A
CR108	025-034	1N457A
CR109	025-034	1N457A
CR114	025-061	1N3287
CR115	025-034	1N457A
CR201	025-034	1N457A
CR351	025-002	1N82AG
CR401	025-016	HD5003
CR501	025-028	1N25
		VARACTOR DIODE
CV501		Factory Selected
CV502		Factory Selected
		FUSE
F1	034-001	1 Amp, 250V
		BULB
I1	011-001	Pilot Light
I2	011-003	82V
		CONNECTORS (J)
J101	020-016	RF, 5069
J102	020-011	RF, UG-625B/U

Connectors (J) continued

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION
J201	020-016	RF, 5069
J301	054-003	Socket, Six Pin
J302	054-003	Socket, Six Pin
J303	054-003	Socket, Six Pin
J304	054-003	Socket, Six Pin
J305	054-003	Socket, Six Pin
J306	054-003	Socket, Six Pin
J307	054-003	Socket, Six Pin
J308	054-003	Socket, Six Pin
J309	020-016	RF, 5069
J310	020-016	RF, 5069
J351	020-017	RF, 5070
J352	020-018	RF, MX1684/U
J353	020-018	RF, MX1684/U
J354	020-018	RF, MX1684/U
J355	020-018	RF, MX1684/U
J401	020-030	RF UG185/U
J402	020-011	RF, UG625B/U
J608	020-050	RF, UG89C/U
J609	020-017	RF, 5070
		INDUCTORS
L301	035-008	10mH Variable
L401		Factory Selected
L402		Factory Selected
L403		Factory Selected
L404		Factory Selected
L501		Factory Selected
L502		Factory Selected
L503		Factory Selected
L504		Factory Selected
L505		Factory Selected
L506		Factory Selected
		CONNECTOR (P)
P1	019-004	Conductor, Line Cord
P352	020-021	RF, UG88C/U
P353	020-021	RF, UG88C/U
P354	020-021	RF, UG88C/U
P606	020-021	RF, UG88C/U
P607	020-021	RF, UG88C/U
P608	020-021	RF, UG88C/U
P609	020-021	RF, UG88C/U

TRANSISTORS

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION
Q1	062-099	MJE1103
Q2	062-100	2N4314
Q4	062-008	2N3440
Q5	062-098	MJE1093
Q6	062-008	2N3440
Q8	062-100	2N4314
Q9	062-055	MJE340
Q10	062-008	2N3440
Q11	062-008	2N3440
Q12	062-008	2N3440
Q13	062-100	2N4314
Q101	062-002	2N3565
Q102	062-002	2N3565
Q103	062-002	2N3565
Q104	062-015	2N3568
Q105	062-015	2N3568
Q106	062-008	2N3440
Q107	062-008	2N3440
Q109	062-012	2N4221
Q201	062-008	2N3440
Q202	062-008	2N3440
Q203	062-015	2N3568
Q204	062-005	2N3053
Q206	062-024	2N3644
Q207	062-024	2N3644
Q301	062-024	2N3644
Q302	062-024	2N3644
Q303	062-024	2N3644
Q304	062-024	2N3644
Q305	062-024	2N3644
Q306	062-024	2N3644
Q307	062-024	2N3644
Q401		Factory Selected
Q402		Factory Selected
Q403		Factory Selected
Q404		Factory Selected
Q501		Factory Selected
Q502		Factory Selected

RESISTORS

R1	046-372	120 ohm, 1W, 10%
R2	046-124	2.2k ohm, $\frac{1}{2}$W, 10%
R3	047-479	1 ohm, $\frac{1}{2}$W, 10%

Resistors continued

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION
R4	046-131	3.3K ohm, ½W, 10%
R5	046-142	5.6K ohm, ½W, 10%
R6	046-442	5.6K ohm, 1W, 10%
R7	048-030	1K ohm Variable
R8	046-124	2.2K ohm, ½W, 10%
R9	046-124	2.2K ohm, ½W, 10%
R10	047-480	2.2 ohm, ½W, 10%
R11	046-131	3.3K ohm, ½W, 10%
R12	046-142	5.6K ohm, ½W, 10%
R13	046-442	5.6K ohm, 1w, 10%
R14	048-030	1K ohm Variable
R15	046-124	2.2K ohm, ½W, 10%
R16	046-480	47K ohm, 1W, 10%
R17	046-463	18K ohm, 1W, 10%
R18	046-166	22K ohm, ½W, 10%
R19	046-456	12K ohm, 1W, 10%
R20	046-479	47K ohm, 1W, 5%
R21	048-026	25K ohm Variable
R22	046-068	100 ohm, ½W, 10%
R23	046-504	180K ohm, 1W, 5%
R24	046-205	180K ohm, ½W, 10%
R25	046-166	22K ohm, ½W, 10%
R101	048-026	25K ohm, Variable
R102	045-794	100K ohm, ¼W, 10%
R103	045-794	100K ohm, ¼W, 10%
R104	045-836	1M ohm, ¼W, 10%
R105	045-780	47K ohm, ¼W, 10%
R106	048-032	1M ohm Variable
R107	045-717	1.5K ohm, ¼W, 10%
R108	048-023	2K ohm Variable
R109	045-717	1.5K ohm, ¼W, 10%
R110	045-710	1K ohm, ¼W, 10%
R111	045-752	10K ohm, ¼W, 10%
R112	045-773	33K ohm, ¼W, 10%
R113	045-787	68K ohm, ¼W, 10%
R114	045-784	56K ohm, ¼W, 10%
R115	045-766	22K ohm, ¼W, 10%
R116	045-826	560K ohm, ¼W, 10%
R117	045-770	27K ohm, ¼W, 10%
R118	045-756	12K ohm, ¼W, 10%
R119	048-054	50K ohm, Variable
R120A,R120B, R120C,S103	048-094	Variable, Switch Assembly, 500K/5K/5M ohm

Resistors continued

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION
R121	045-745	6.8K ohm, ¼W, 10%
R122	045-714	1.2K ohm, ¼W, 10%
R123	046-122	2K ohm, ½W, 5%
R124	045-668	100 ohm, ¼W, 10%
R125	046-208	220K ohm, ½W, 10%
R127	046-093	390 ohm, ½W, 10%
R128	048-023	2K ohm, Variable
R129	045-742	5.6K ohm, ¼W, 10%
R131	048-023	2K ohm, Variable
R132	045-738	4.7K ohm, ¼W, 10%
R133	045-696	470 ohm, ¼W, 10%
R134A,R134B, S101	048-047	Variable, Switch Assembly, 500/50 ohm/3P3Pos.
R135	045-703	680 ohm, ¼W, 10%
R136	045-703	680 ohm, ¼W, 10%
R137		Factory Selected
R138	048-024	5K ohm, Variable
R141	048-054	50K ohm, Variable
R142		Factory Selected
R143		Factory Selected
R144		Factory Selected
R145	045-752	10K ohm, ¼W, 10%
R146		Factory Selected
R147	046-194	100K ohm, ½W, 10%
R148	046-477	39K ohm, 1W, 10%
R149	046-477	39K ohm, 1W, 10%
R151	046-191	82K ohm, ½W, 10%
R152		Factory Selected
R153	045-752	10K ohm, ¼W, 10%
R154		Factory Selected
R155		Factory Selected
R156		Factory Selected
R157	048-054	50K ohm, Variable
R161	045-714	1.2K ohm, ¼W, 10%
R162	045-717	1.5K ohm, ¼W, 10%
R163	048-023	2K ohm, Variable
R164	048-050	1K ohm, Variable
R165	045-665	82 ohm, ¼W, 10%
R166	046-135	3.9K ohm, ½W, 10%
R167	048-022	500 ohm, Variable
R168	045-756	12K ohm, ¼W, 10%
R169	045-773	33K ohm, ¼W, 10%
R179	045-794	100K ohm, ¼W, 10%

Resistors continued

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION
R180	045-815	330K ohm, ¼W, 10%
R181	045-794	100K ohm, ¼W, 10%
R201	045-647	33 ohm, ¼W, 10%
R202	045-759	15K ohm, ¼W, 10%
R203	045-752	10K ohm, ¼W, 10%
R204	045-703	680 ohm, ¼W, 10%
R205	045-766	22K ohm, ¼W, 10%
R206	045-738	4.7K ohm, ¼W, 10%
R207	045-738	4.7K ohm, ¼W, 10%
R208,S201, S701	048-059	Variable, Switch Assembly, 50K ohm/4P2T
R209	048-036	5K ohm, Variable
R210	048-036	5K ohm, Variable
R211	045-766	22K ohm, ¼W, 10%
R212	045-749	8.2K ohm, ¼W, 10%
R213	045-665	82 ohm, ¼W, 10%
R214	045-696	470 ohm, ¼W, 10%
R215	045-836	1M ohm, ¼W, 10%
R216	045-780	47K ohm, ¼W, 10%
R217	045-794	100K ohm, ¼W, 10%
R218	045-752	10K ohm, ¼W, 10%
R219		Factory Selected
R221	045-780	47K ohm, ¼W, 10%
R222	045-794	100K ohm, ¼W, 10%
R223	045-763	18K ohm, ¼W, 10%
R224	045-801	150K ohm, ¼W, 10%
R301	045-752	10K ohm, ¼W, 10%
R302	045-808	220K ohm, ¼W, 10%
R303	045-710	1K ohm, ¼W, 10%
R304	045-710	1K ohm, ¼W, 10%
R305	048-014	10K ohm, Variable
R306	048-014	10K ohm, Variable
R307	045-668	100 ohm, ¼W, 10%
R308	045-808	220K ohm, ¼W, 10%
R309	045-710	1K ohm, ¼W, 10%
R310	045-710	1K ohm, ¼W, 10%
R311	048-014	10K ohm, Variable
R312	048-014	10K ohm, Variable
R313	045-668	100 ohm, ¼W, 10%
R314	045-808	220K ohm, ¼W, 10%
R315	045-710	1K ohm, ¼W, 10%
R316	045-710	1K ohm, ¼W, 10%
R317	048-014	10K ohm, Variable
R318	048-014	10K ohm, Variable

Resistors continued

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION
R319	045-668	100 ohm, ¼W, 10%
R321	045-808	220K ohm, ¼W, 10%
R322	045-710	1K ohm, ¼W, 10%
R323	045-710	1K ohm, ¼W, 10%
R324	048-014	10K ohm, Variable
R325	048-014	10K ohm, Variable
R326	045-668	100 ohm, ¼W, 10%
R327	045-738	4.7K ohm, ¼W, 10%
R328	045-808	220K ohm, ¼W, 10%
R329	045-689	330 ohm, ¼W, 10%
R331,S309	048-079	Variable, Switch Assembly, 100K ohm/SPST
R332	045-808	220K ohm, ¼W, 10%
R333	045-686	270 ohm, ¼W, 10%
R334	045-752	10K ohm, ¼W, 10%
R335		See R339
R336	045-752	10K ohm, ¼W, 10%
R337	045-836	1M ohm, ¼W, 10%
R338	045-686	270 ohm, ¼W, 10%
R339A,R339B, R335	048-060	Variable, 100K/100K/25K ohm
R341	046-180	47K ohm, ½W, 10%
R342	045-752	10K ohm, ¼W, 10%
R343	045-752	10K ohm, ¼W, 10%
R351	045-682	220 ohm, ¼W, 10%
R352	045-752	10K ohm, ¼W, 10%
R353	045-658	56 ohm, ¼W, 10%
R354	045-658	56 ohm, ¼W, 10%
R355	045-696	470 ohm, ¼W, 10%
R356	045-672	120 ohm, ¼W, 10%
R357	045-672	120 ohm, ¼W, 10%
R401	045-717	1.5K ohm, ¼W, 10%
R402	045-752	10K ohm, ¼W, 10%
R403	045-640	22 ohm, ¼W, 10%
R404	045-654	47 ohm, ¼W, 10%
R405	046-051	39 ohm, ½W, 10%
R406	045-749	8.2K ohm, ¼W, 10%
R407	045-640	22 ohm, ¼W, 10%
R408	045-647	33 ohm, ¼W, 10%
R409	045-703	680 ohm, ¼W, 10%
R411	045-654	47 ohm, ¼W, 10%
R412	046-056	51 ohm, ½W, 5%

Resistors continued

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION
R413	045-647	33 ohm, ¼W, 10%
R414	045-640	22 ohm, ¼W, 10%
R415	045-728	2.7K ohm, ¼W, 10%
R416	045-693	390 ohm, ¼W, 10%
R417	045-647	33 ohm, ¼W, 10%
R418	046-040	22 ohm, ½W, 10%
R419	045-745	6.8K ohm, ¼W, 10%
R420	045-612	4.7 ohm, ¼W, 10%
R421	045-728	2.7K ohm, ¼W, 10%
R422	045-654	47 ohm, ¼W, 10%
R423	045-626	10 ohm, ¼W, 10%
R424	045-752	10K ohm, ¼W, 10%
R425	045-747	7.5K ohm, ¼W, 10%
R426	045-630	12 ohm, ¼W, 10%
R427	046-386	270 ohm, 1W, 10%
R428	045-626	10 ohm, ¼W, 10%
R429	045-640	22 ohm, ¼W, 10%
R430	045-612	4.7 ohm, ¼W, 10%
R431	045-626	10 ohm, ¼W, 10%
R432	046-682	220 ohm, 2W, 10%
R433	045-682	220 ohm, ¼W, 10%
R434		Factory Selected
R435	045-693	390 ohm, ¼W, 10%
R436	045-710	1K ohm, ¼W, 10%
R501	045-759	15K ohm, ¼W, 10%
R502	045-745	6.8K ohm, ¼W, 10%
R503	045-654	47 ohm, ¼W, 10%
R504	045-466	22K ohm, 1/8W, 10%
R505	046-040	22 ohm, ½W, 10%
R506	045-759	15K ohm, ¼W, 10%
R507	045-745	6.8K ohm, ¼W, 10%
R508	045-654	47 ohm, ¼W, 10%
R509	045-466	22K ohm, 1/8W, 10%
R510	045-682	220 ohm, ¼W, 10%
R511	045-878	10M ohm, ¼W, 10%
R512	045-700	560 ohm, ¼W, 10%
R513	045-686	10 ohm, ¼W, 10%
R514		Factory Selected
R515	045-878	10M ohm, ¼W, 10%

SWITCHES

S1	057-004	SPST Toggle
S101		See R134A and R134B

Switches continued

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION
S102	057-003	Slide
S103		See R120A, R120B, and R120C
S201		See R208
S301	057-016	Rocker
S302	057-016	Rocker
S303	057-016	Rocker
S304	057-016	Rocker
S305	057-016	Rocker
S306	057-016	Rocker
S307	057-016	Rocker
S308	057-016	Rocker
S309		See R331
S701		See R208
		TRANSFORMER
T1	B061-009	Power
		DIODES
VR1	025-018	5.6V Zener, 5%, 1N708A
VR2	025-033	7V Zener, 5%
VR3	025-033	7V Zener, 5%
VR4	025-018	5.6V Zener, 5%, 1N708A
VR5	025-033	7V Zener, 5%
VR6	025-033	7V Zener, 5%
VR7	025-011	24V Zener, 5%
VR8	025-038	15V Zener
VR101	025-018	5.6V Zener, 5%, 1N708A
VR201	025-024	28V Zener, 5%
		MISCELLANEOUS
Z401	A204-230	Termination, Feedthru
Z501	A204-228	Filter
Z601	A200-005-01	Termination
Z602	A200-005-01	Termination
Z603	B200-200-01	Attenuator
Z604	B200-200-00	Attenuator

CONDICTIONS OF SALE

Determination of prices, terms, conditions of sale, and final acceptance of orders are made only at our plant in Indianapolis, Indiana.

All prices are F.O.B. Indianapolis, Indiana, USA.

Terms in the United States and Canada are Net 30 days if credit has been arranged.

Terms throughout the rest of the free world are arranged with Texscan's area representative.

SERVICE AND PARTS

Repair service is available at our plant in Indianapolis, Indiana. Before returning an instrument for repair, please write to us, requesting a Returned Material Authorization. On receipt of shipping authorization, forward the instrument prepaid. Care should be taken in packing the instrument to insure protection in transit. Also, state the type and serial number of the instrument, date of purchase, and details concerning the difficulty.

Repair parts may be ordered from our home plant or through our sales representatives. When ordering repair parts, please specify the part number and description of the item, and the type and serial number of the instrument in which it is used.

TEXSCAN RECOMMENDS FACTORY REPAIR OF RF CIRCUITS

If failure occurs in an RF section of any TEXSCAN test instrument, TEXSCAN recommends that the complete instrument be returned to the factory for repair and calibration. Replacement of an RF assembly or component may result in failure of the instrument to meet its published specifications and failure to perform within its design capabilities. TEXSCAN Customer Service personnel are experienced in the repair and calibration of the complete line of TEXSCAN test instruments. When practical, updated improvements can be included in the reapired instrument.

SPECIFICATION CHANGES

The right is reserved to change the published specifications of equipment at any time, and to furnish merchandise in accordance with current specifications without incurring any liability to modify equipment previously sold.

WARRANTY

Products manufactured by Texscan Corporation are warranted against defective materials and workmanship for one year from date of shipment. Any instrument or component which has been found to be defective during this one-year period will be repaired or replaced without charge except for vacuum tubes or batteries which have given normal service. No other warranty is expressed or implied.

ORDERING INFORMATION

In the United States and Canada, please order through your local representative or directly with the factory. Your factory trained representative can supply technical data and latest price and delivery quotations.

The factory address is:

TEXSCAN CORPORATION
2446 N. Shadeland Avenue
Indianapolis, Indiana 46219
Phone: 317-357-8781
TWX: 810-341-3184
Cable Address: TEXSCAN

In Western Europe, please order through your local representative, who can supply technical assistance and up-to-date price and delivery information.

Complete addresses and telephone numbers of Texscan's sales representatives are listed on the outside back cover of the catalogue.

SHIPPING INSTRUCTIONS

Unless specific instructions accompany the order, we shall use our own judgement as to the best method of shipment. Unless otherwise specified, normal shipments will be by air freight or air express. Small items are sent via parcel post. The listed price for our products include the packing, but does not include the cost of shipping.

IMPORTANT!

WARRANTY AND SERVICE INFORMATION

Products manufactured by TEXSCAN CORPORATION are warranted, to the original purchaser, against defective material and workmanship for a period of one year from the original date of shipment from our plant. This warranty is limited to the replacement or repair of components or parts found defective within this one-year period, including the labor involved in their replacement, when the product is returned, shipping charges prepaid, to our factory in Indianapolis, Indiana. It does not apply to normal service items, such as batteries, tubes or appearance items which have given normal service, nor does it apply to damage caused by abuse, misuse, mishandling, or damage caused by shipment, unauthorized modification, repair or attempted repair. In fulfilling this warranty, TEXSCAN'S liability is limited to the repair of this product. The company assumes no liability for any consequential damage.

In the event that you experience difficulty with this unit, please write Customer Service Dept., TEXSCAN CORP., 2446 N. Shadeland Avenue, Indianapolis, Indiana 46219, or call (317) 357-8781. If return of this unit to TEXSCAN is authorized, you will be given a Repair Authorization number, which must be marked on the outside of the shipping container. Enclose the additional information requested below and forward the unit, shipping charges prepaid, to TEXSCAN. All service work is FOB our plant in Indianapolis, Indiana.

Overseas customers should contact our local sales representatives.

Service is also available, at nominal cost, for older TEXSCAN products. Please follow the same procedure described in the preceding paragraph, even though you are requesting non-warranty repairs. Not only will you help expedite the unit to Customer Service, but you will also have established your priority.

All units handled by our Customer Service Dept. are carefully re-inspected by our Quality Assurance Dept. to ensure that they function in accordance with the specifications which were applicable at the time of their manufacture. We reserve the right to make product improvements and changes, without incurring any liability to modify equipment previously sold. However, we do occasionally find it more expedient to update portions of older models rather than attempt repairs.

Should you desire to perform repairs in your own facility, approved replacement parts may be purchased through our Customer Service Dept. Please order by TEXSCAN part number and specify the model and serial number of the instrument in which it is to be used.

REPAIR AUTHORIZATION NO._____DATE_____YOUR P.O.NO._____

TYPE OF EQUIPMENT_____MODEL_____

SERIAL NUMBER_____DATE OF PURCHASE_____

OWNER'S NAME & ADDRESS_____

FOR FURTHER INFORMATION, CONTACT_____

DESCRIPTION OF PROBLEM_____

_____